University of Malaya

Fakulti Sains Komputer dan Teknologi Maklumat

Project Title:
An E-Commerce System for Sales and Purchase Order Management of Machinery Hardware

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WXES 3182:Project Ilmiah Tahap Akhir II
(2001/2002)

This thesis is submitted to Faculty of Computer Science and Information Technology University of Malaya in partial fulfilment of the requirement for the Bachelor of Computer Science Degree

Abstract

This report documents the explanations and descriptions of doing online business, which is defined as E-Commerce system, requirements and designs of the project. Therefore, this documentation is including four chapters which also describing the introduction, literature review, system analysis, methodology and design of the system.

This report is introducing the project scopes initially. It describes the actual meaning of the online sales and purchases order, the purposes of using the online technique to do business, objectives and outcomes of the project. The Literature Review summarized the findings and reports the background of the project topic. System Analysis and Methodology chapter gives a detail description to the analysis requirements; approach to be adapted and other general statements. In the Chapter of System Design, Data Flow diagrams and flowcharts are drawn to present the flows of the system modules and the whole system.

Moreover, this report will show the System Implementation, system Testing and System Evaluation part. The System Implementation describes the stage to change the thing from the scratch to the reality. The flowchart design for each module and the file structure design for each table in the database as well as the interface design are move from the design scratch to the real implementation stage by using hardware development requirement and software development tools.

The System Testing describes the process of executing a program with the intention of finding bugs, errors or defects that present in the system. System testing also can be defined as the process of analyzing a software item to detect the difference between existing and required conditions and to evaluate the features of the software items.

Also, the System Evaluation can be described as conclusion, which will show various problems were encountered. These entire problems were solved through research and studies. Every system also has it own strengths, limitations and future enhancements where can be identified.

Acknowledgement

The greatest pleasure of doing this project is acknowledging the efforts of my project supervisor, Assoc. Prof. Dr. Lee Sai Peck, (Assoc. Prof. of Faculty of Computer Science and Information Technology) for guiding me on my project. Dr. Lee had shared her valuable opinions and experiences and put them in my project.

My thanks also go to my project moderator, Cik Nazean Jomhari, (Lecturer of Faculty of Computer Science and Information Technology) for his useful suggestion.

Besides, I would like to thank Mr. Tey Kok Keong, as the manager of NH TRADING SDN BHD, one of the member of The NH Group for his valuable opinions and idea of the business flow of the company. He also share his very useful introduction of the company products.

I also would like to give my special thanks to all of my course-mates who had help me before in doing this project and those who had solved my problems. They really are pleasure to give their hands in anything, which is related in my project. My greatest thanks fly to my family members for their encouragement, motivation and moral support at home.

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1.0 Introduction

Essentially, people are using the web for buying and selling items and services over the Internet. It is quick, it is convenient, and never need to leave their desk. Even people who prefer to shop off-line are researching products on the web. These days when people are trying to find the website they need, the first place they look is on the web.

The web site can be used for a large number of tasks such as:

- Making public announcements
- Providing support to customers
- Receiving feedback from visitors
- Sharing or distributing files and images
- Selling products

Five years ago, people were having a Web site was a vanity. Two years ago having a Web site was trendy. Today having a Web site is a necessity, and of cause the world Internet commerce market is expected to grow to a very big figure.

Therefore, the idea of building a secure E-commerce System for Sales and Purchase Order Management of Machinery Hardware is used. The connection between the Web browser and the Web server will in a secure manner by using the Secure Socket Layer (SSL) channel, because the data is encrypted using digital certificates that both sides have.

1.1 The E-Commerce System

1.1.1 Definition

E-Commerce is a concept covering business transactions within a global information economy. It encompasses electronic trading of goods and services, online delivery of digital content, electronic fund transfer, electronic share trading, electronic bill of lading, commercial auctions, online sourcing and procurement, collaborative design and engineering, direct consumer marketing and online services.

E-Commerce involves the application of information and communications technology that automates and redesigns business transactions and workflow on the secure, real-time Internet backbone. The ultimate outcome is to bring down the cost of doing business globally and efficient utilization of resources.

E-commerce merchants can range from the small business with a few items for sales all the way to a large online retailer such as *Amazon.com* where the books are sold across the website. Nowadays, the number of the companies which are doing their business over the Internet are increasing very fast and they are divided into exist solely companies and companies which are using the Internet to compliment their existing businesses [1].

1.1.2 Purposes of Using The E-commerce System

E-Commerce can offer the companies both short-term and long-term benefits. Therefore, there are some reasons that make them take part in this system of trend. The reasons are [1]:

- Open new and wide markets, enabling companies to reach new customers.
- Easier and faster for companies to do businesses with their existing customer base.
- Moving business practices, such as ordering, invoicing, and customer support, to network-based system can also reduce the paperwork involved in business-to-business or business-to-customer transactions.
- When more of our information is digital, they can better focus on meeting their customers' needs.

- Tracking customer satisfaction, requesting more customer feedback, and presenting custom solutions for their client are just some of the opportunities.
- An cheaper easier and faster way to advertise and market products over the Internet. So, the companies can reduce overhead cost, it is simply because it is not spending as much money on buildings and customer service as compared to a typical traditional business.
- The number of the Internet users is increasing and most of the information on the Internet is needed for their daily use.
- Many of the existing secure E-commerce website are created to gain more confidence of making sales and purchase order on the Internet.

Regarding to the reasons above, we can know that many of the companies are already making their steps to do businesses over the Internet. Senheng [3], which is selling their electrical items not only direct to customer, but also through the Internet in Malaysia. Customers can purchase items on the Internet and get the items in short because the company have many branches around the country.

The diagram below shows the general operation of an E-commerce system which many of the company who involves in the application around the world.

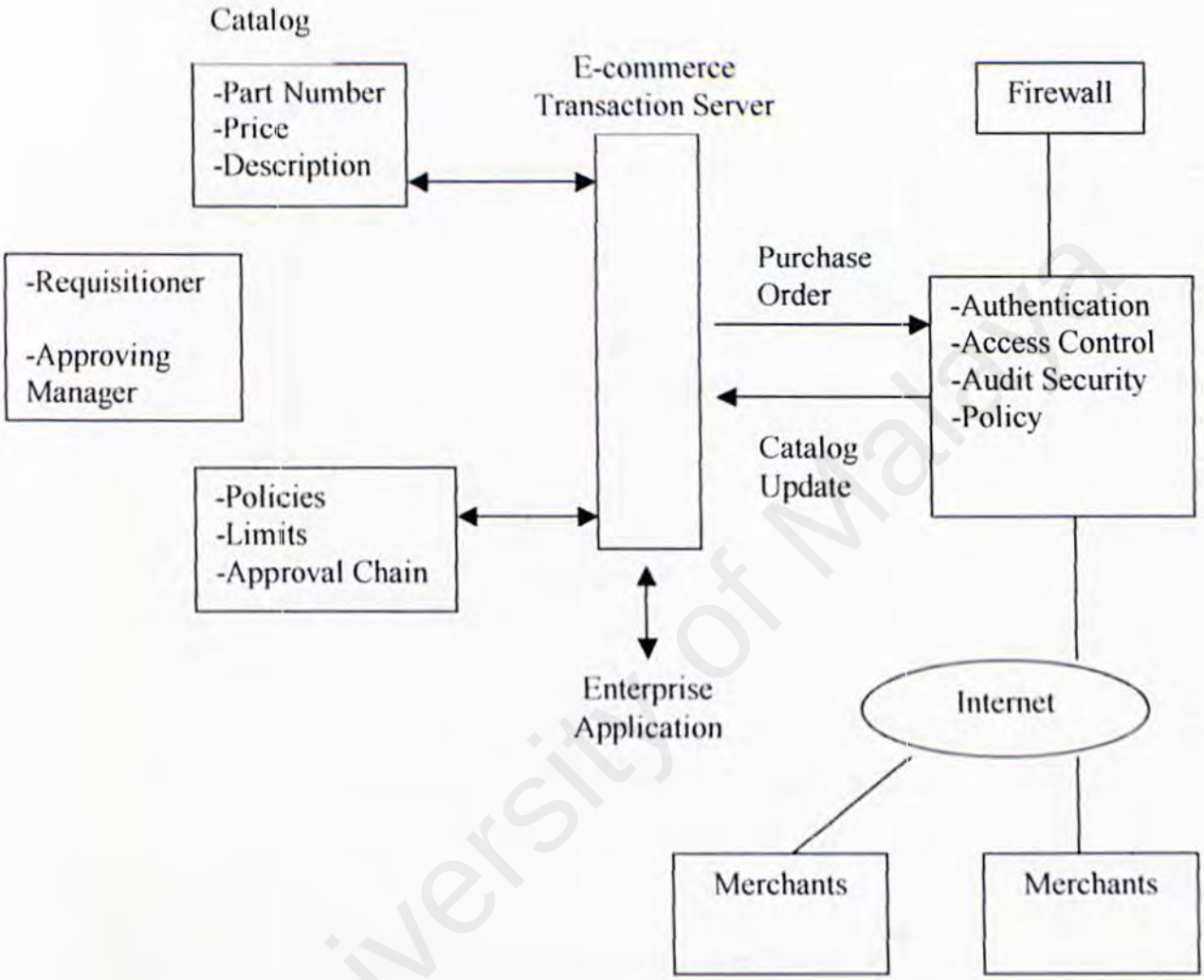


Figure 1.1 E-Commerce Application System

The operating of the E-commerce application above will produce life cycle for every process is done. The life cycle is shown below:

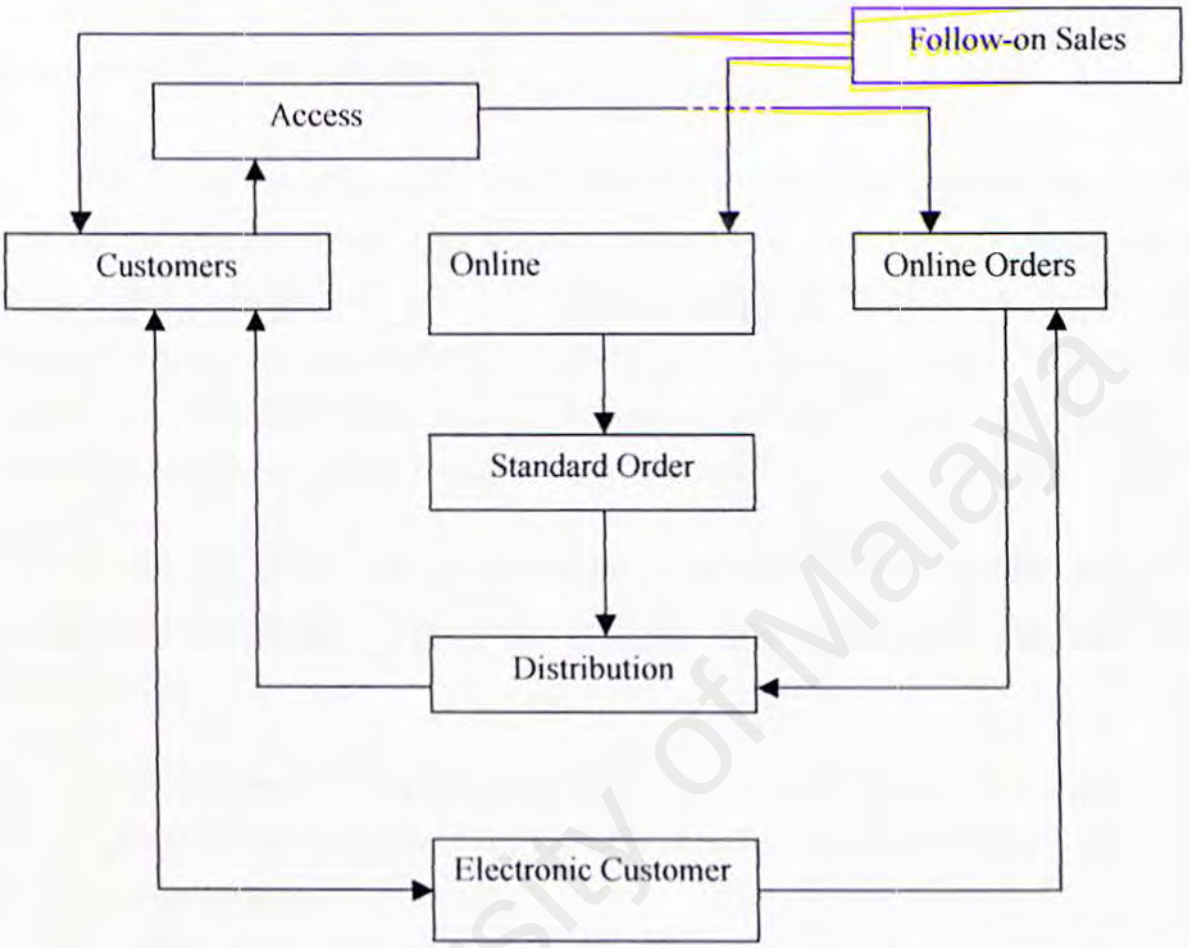


Figure 1.2 A Cycle Of E-commerce System

1.2 Problem Definition

This project will try to limit the security problem while each transaction of payment is running through the website of merchant

When conducting the transaction over the Internet, users will beware of the security that an E-commerce system has. This is because; the users or clients who are taking part in the system will consider their way to make their money transaction over the Internet. Therefore, many options abound when it comes to payment. These are depends on the clients, whether their will use credit cards, debit cards, purchase order or customer accounts. But for the most part, e-commerce transactions are credit card-based.

Normally, the clients do not charge the cards until the products are shipped or delivered to them. Actually, most credit card transactions work over the Internet as mentioned below:

1. Authentication. It's a good idea to make sure the cards which the merchant are accepting have valid numbers, have actually been issued, and are not reported stolen.
2. Authorization. This process checks whether funds are available for purchases.
3. Settlement. Once the merchant have shipped the products or delivered them to the clients, then the merchant let the banks know. The banks will release the funds that were previously reserved, and the money will make its way through numerous banks and intermediaries into the merchant's account.

To ensure the security is always been protected, Secure Socket Layer (SSL) and Secure Electronic Transaction (SET) are introduced by Netscape to lead protocols for securing the online purchase process [2]. SSL and SET are the encryption technology that scrambles a message so that only the recipient can unscramble it. This is good for online merchants because it reduces online transaction risk and increases customer confidence. People are much more willing to supply their credit card information when they are sure that no one can see it but the intended merchant.

1.3 Scope Defined

Some analysis of the existing EC websites show that, most problems are large and sometimes tricky to handle, especially if they represent something new that has never been solved before. Breaking the problem into pieces that we can understand and try to deal with solves this problem.

This project will base on an E-commerce (EC) system for clients or any users who looking for a machinery hardware company's web site to purchase online and allow them to purchase the machinery hardware which sold by the company by using a secure connection between clients and secure web server through the Internet.

The application will promote and sell the company products by publishing Web pages that are static and creating the dynamic products order forms and other necessary forms or cards to be filled up by those potential clients. It able to process the request from the customers (the clients of the system).

1.4 Project Objectives

Besides building an interactive web-based application and do a survey of the existing technologies, this system is also have the main objective to serve as a platform for testing the use of HTTPS protocol as a secured protocol replacing the conventional HTTP protocol. The system will ensure up-to-date statistical information on purchases and suppliers such as reports of purchases history, list of suppliers and outstanding purchase orders.

When customer and merchant use the platform, the business is considered to be begun. The creation of the system is to provide a user friendly and interactive interface for the purchase system – graphical user interface (GUI), self-explanatory, easy-to-use menu and also reduced paperwork and paper load so that it is easy to audit as everything is in digital format.

1.5 The Expected Outcome

This system will be an application that runs in the secure web server (in Microsoft Windows 2000 platform) that allows Web surfers to view the contents (the machinery hardware catalogue) of the specified company's Web pages and purchase online. The information that is required when the transaction is conducted will be stored in a well-designed database that can be concerned and manipulated easily and efficiently.

This is also including the payment transaction, which either use credit card or money order. Therefore, the transaction should be made in a secured Internet Payment System.

1.6 Project Schedule

To complete the whole project, it is divided into four phases:

1.6.1 Project Overview

Present the introduction and overview of the scopes, which related to the project.

1.6.2 System Analysis and Design

This includes the system study, analysis of current E-Commerce systems, understanding the concept of system, define the scope and domain, determine as well as learning of the software tools to be used. This project will also do the system architecture design, web page design, database design, user interface design, design of the integration of the software development tools in the application.

1.6.3 Coding

This project will created by using the Active Server Pages because it's coding is supported by (ASP) application, Microsoft SQL Server, user interface and so on.

1.6.4 Deployment and System Evaluation

Testing and debugging: the documentation of the whole project will conduct from the beginning until the end of the project. *(See the schedule table at Figure 1.3)*

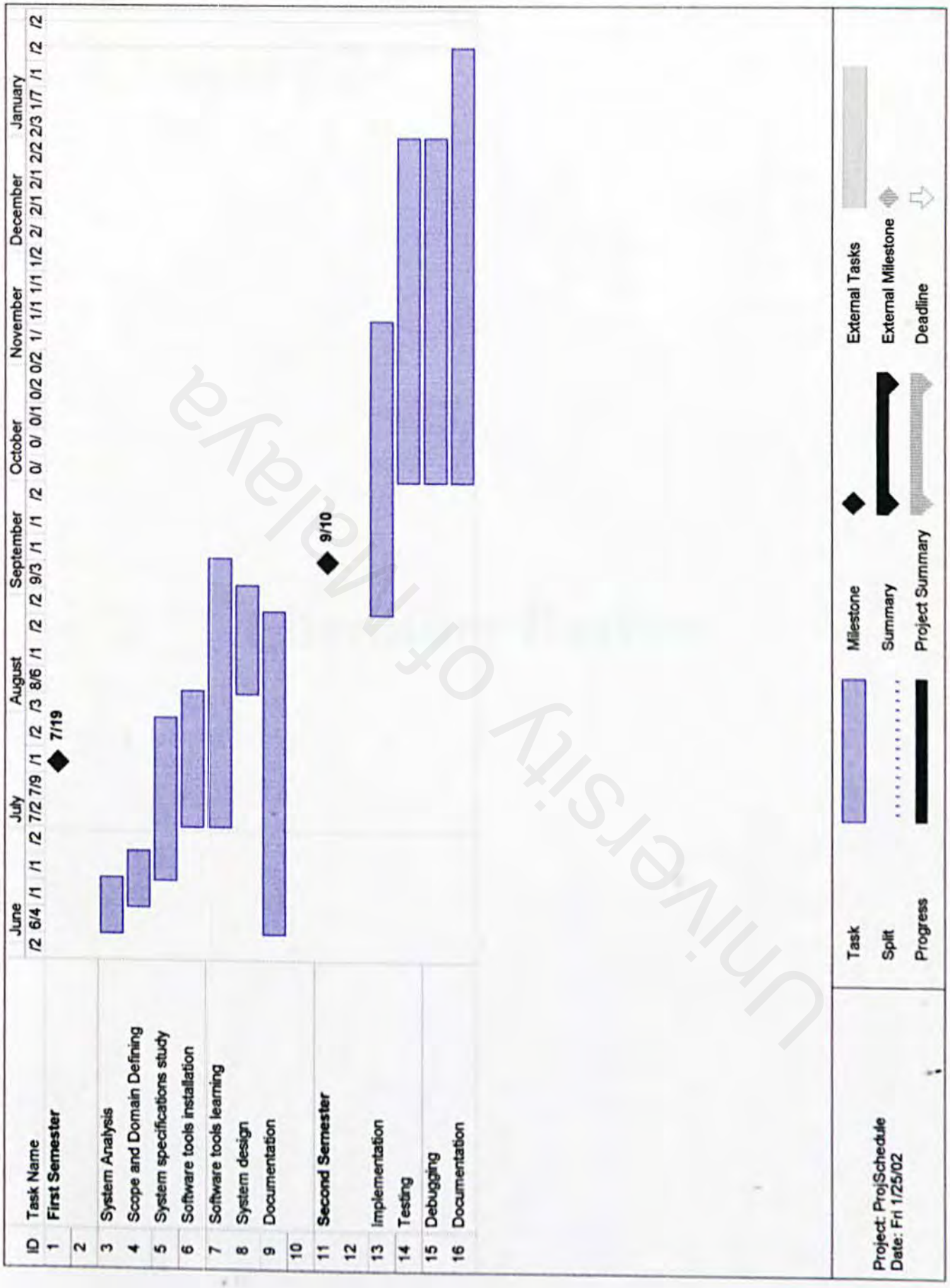


Figure 1.3 Project Schedule

2.0 Literature Review

2.1 The Internet and the World Wide Web (WWW)

A technical definition of the World Wide Web is: all the resources and users on the Internet that are using the Hypertext Transfer Protocol (HTTP). A broader definition comes from the organization that Web inventor Tim Berners-Lee helped found, the World Wide Web Consortium (W3C):

> "The World Wide Web is the universe of network-accessible information, an embodiment of human knowledge."

The Web was formed in 1989 at the European Particle Physics lab as a way for scientists around the world to share information via the Internet. The Web consists of servers that present documents to an end user for viewing. These documents, or pages, can contain links to other servers anywhere in the world. The faster growing segment of the Internet today, the Web has grown from less than 50 Web sites in 1990 to over 13,000 in 1995.Due to the huge media explosion of the Web, most new computers are equipped with a Web browser preinstalled. The introduction of the Web has enabled an easy marriage between corporate information and an easy-to-use, common graphical user interface.

2.2 Hypertext Transfer Protocol (HTTP)

HTTP is a protocol with the lightness and speed necessary for a distributed collaborative hypermedia information system. It is a generic stateless object-oriented protocol, which may be used for many similar tasks such as name servers, and distributed object-oriented systems, by extending the commands, or "methods", used. A feature if HTTP is the negotiation of data representation, allowing systems to be built independently of the development of new advanced representations.

When many sources of networked information are available to a reader, and when a discipline of reference between different sources exists, it is possible to rapidly follow references between units of information, which are provided at different remote locations. As response times should ideally be of the order of 100ms in, for example, a hypertext jump, this requires a fast, stateless, information retrieval protocol.

On the Internet, the communication takes place over a TCP/IP connection. This does not preclude this protocol being implemented over any other protocol on the Internet or other networks. In these cases, the mapping of the HTTP request and response structures onto the transport data units of the protocol in question is outside the scope of this specification. It should not however be at all complicated.

2.3 Transmission Control Protocol / Internet Protocol (TCP/IP)

TCP and IP were developed by a Department of Defence (DOD) research project to connect a number different networks designed by different vendors into a network of networks (the Internet). It was initially successful because it delivered a few basic services that everyone needs (file transfer, electronic mail, remote logon) across a very large number of client and server systems. Several computers in a small department can use TCP/IP (along with other protocols) on a single LAN [4].

The IP component provides routing from the department to the enterprise network, then to regional networks, and finally to the global Internet. On the battlefield a communications network will sustain damage, so the DOD designed TCP/IP to be robust and automatically recover from any node or phone line failure. This design allows the construction of very large networks with less central management. However, because of the automatic recovery, network problems can go undiagnosed and uncorrected for long periods of time.

As with all other communications protocol, TCP/IP is composed of layers:

- IP - Responsible for moving packet of data from node to node. IP forwards each packet based on a four-byte destination address (the IP number). The Internet authorities assign ranges of numbers to different organizations. The organizations assign groups of their numbers to departments. IP operates on gateway machines that move data from department to organization to region and then around the world.
- TCP - Responsible for verifying the correct delivery of data from client to server. Data can be lost in the intermediate network. TCP adds support to detect errors or lost data and to trigger retransmission until the data is correctly and completely received.
- Sockets - A name given to the package of subroutines that provide access to TCP/IP on most systems.

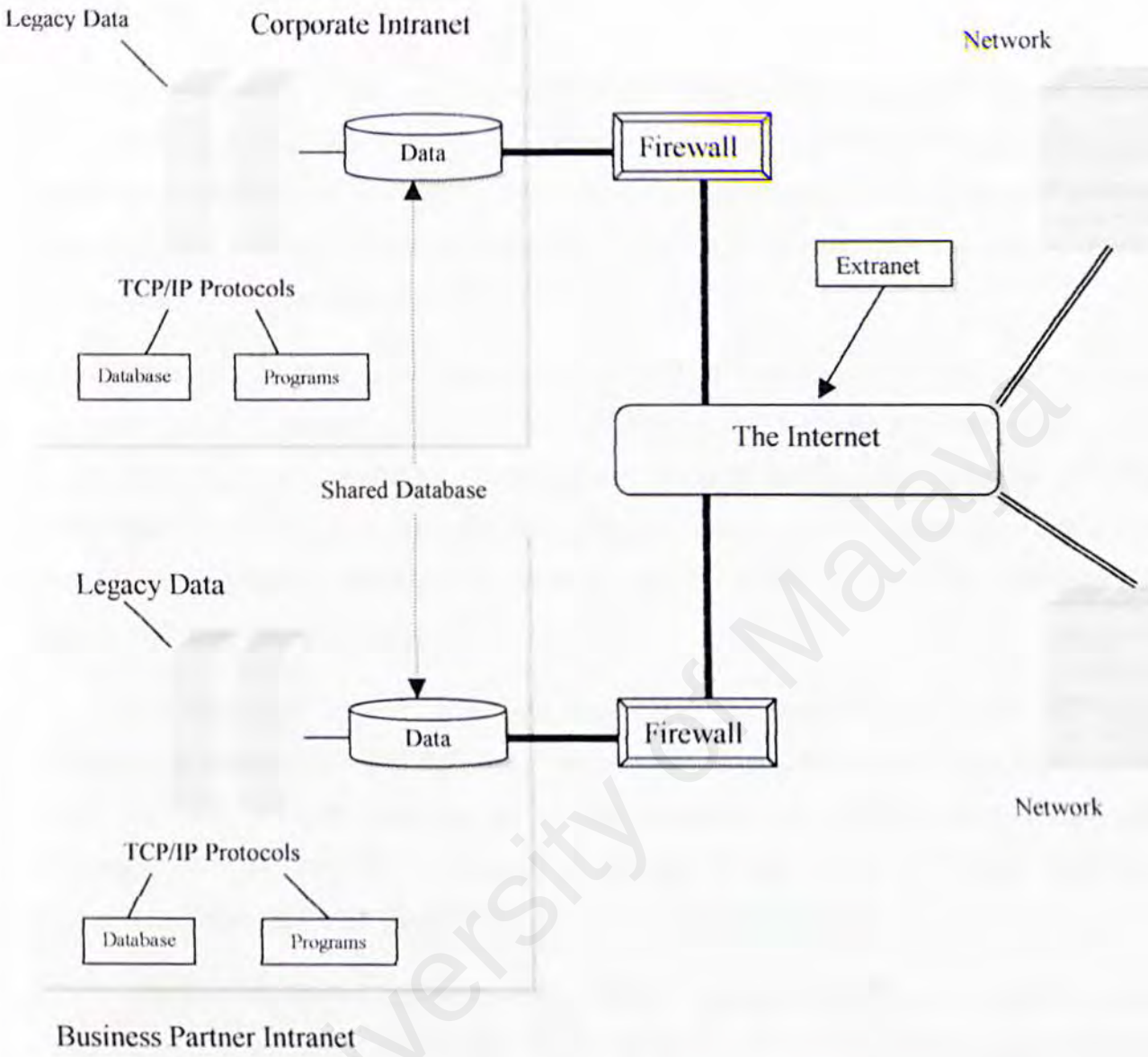


Figure 2.1 The Network of System

2.4 E-Commerce Security - Cryptography with SET and SSL

The emergence of Internet as a vehicle underlying the information revolution, which provides the universal connectivity, has bought E-Commerce to the brink of widespread deployment. However, as Internet connections are passed through many gates and servers, the opportunity is there for the information to be intercepted by other parties unless measures are taken to close these open channels.

With this in mind, many people are awaked of security issues such as fraudulent transactions and malicious hackers before they jumping into E-Commerce bandwagon. This is also one reason why some merchants are unwilling to conduct their business in cyber world, thereby, limited E-commerce to grow. Hence, there is a driving need to create a safe and trusted purchasing environment to overcome these security barriers, enabling full potential of Internet e-commerce.

One emerging answer is Secure Electronic Transaction (SET). The SET is a messaging protocol developed by Visa, Master Card, American Express and Japan's JCB credit card with the help from several leading technology companies including IBM and Microsoft. SET is specifically designed to provide a mechanism for secure electronic payment by credit card over an otherwise very insecure public Internet.

Another alternative approach, SSL (Secure Sockets Layer) is a general-purpose program layer created by Netscape for managing the security of message transmissions in a network, which operates above the Internet TCP protocol. It is the most commonly used protocol that secures data sent between SSL-enabled Web browsers and Web servers. Any URL commencing with "https://" indicates use of HTTP protected by SSL [5].

SET has been exercised in more than a hundred-trail deployment internationally, however, the adoption and deployment of SET solutions have been slower than expected, particularly in US. While the 3-year-old SET is currently being tested and developed, E-commerce is now growing based on early-adoptioners' use of credit card over SSL. Furthermore, SSL is already a standard part of most of the browsers including Netscape and Internet Explorer, SET is still not yet in wide distribution at the moment. Besides, the

combination of SSL and fraud detection software has provided adequate protection for customers and merchant at a lower cost.

2.4.1 Cryptography and Authentication

This session briefly explains how the protocols use RSA key Cryptography to secure the information over open network. Both protocols use public key cryptography for authentication purposes.

2.4.2 Public key encryption

According to Netscape's definition, public key encryption is a technique that uses a pair of asymmetric key for encryption and decryption, where each pair of key consists of a public and a private key. Data that is encrypted with the public key can be decrypted with the private key. Conversely, data encrypted with the private key can be decrypted only with the public key.

2.4.3 Using public key for authentication

SSL requires merchant to obtain a digital certificate from a neutral, trusted certifying authority **(CA)** [6] such as VeriSign Inc. for merchant authentication purpose. The certificate typically contains the information of public key, owner's s name, expiration date of the public key, name of the issuer (the CA that issued the Digital ID), Serial number of the Digital ID and Digital signature of the issuer. The certificate is signed using the CA's private key and the public will know the public key.

SSL protocol starts with a handshake phase. This handshake results in the client and server agreeing on the level of security they will use and fulfils any authentication requirements for the connection.

First, the merchant server will present to the customer's browser its certificate, for browser to validate if it has been signed by a trusted CA. If a CA has signed on the certificate, cardholder is convinced that the merchant is safe to shop.

Once knowing the merchant is legitimate, the SSL software in the browser will generate a random message encrypted with the merchant's public key and send over to the server. In this case, only the right server can decrypt the message thus the identity can be proved. Therefore, even though the conversation is being observed, it remains inaccessible to third parties, as they have no access to the encryption key.

Undoubtedly, SSL can protect the confidentiality of the exchanged data. The downside is, cardholder run the risk that a merchant may expose their credit card numbers on its server, and merchants run the risk that a consumer's credit card number is fraudulent or that the credit card won't be approved. However, the emergence of SET solved the problems.

2.4.4 SET provides cross-authentication

Like SSL, SET allows for merchant's identity to be authenticated via digital certificates. However, SET certificates actually go beyond this where it is necessary for the customer to prove his identity to the merchant as a valid cardholder. In fact, all involving parties -- cardholder, merchant, bank and anyone else are required to obtain digital certificates, which rooted in a SET common key. Each certificate is signed with private key of parent, assuring that each party that all others are authorized to play role required of them.

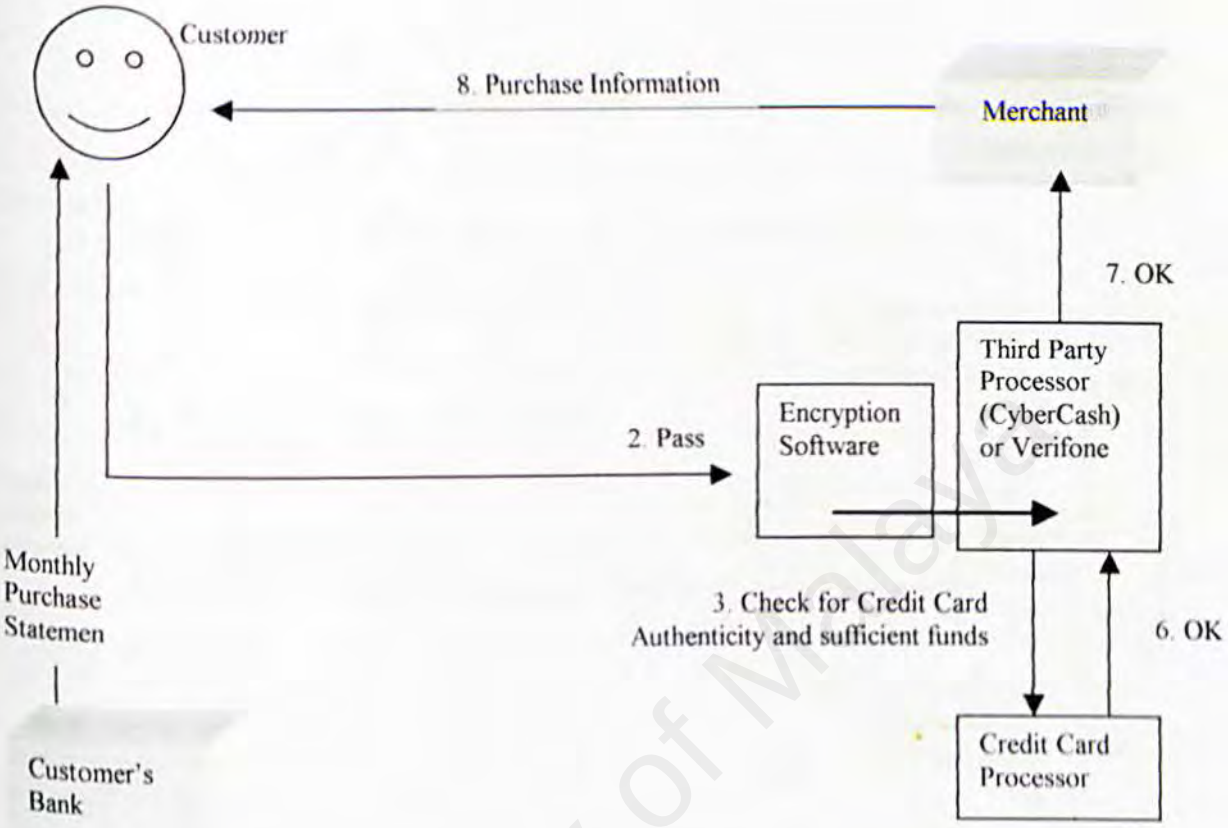


Figure 2.2(a) Online Credit Card Transaction Process (Customer Pay to Merchant)

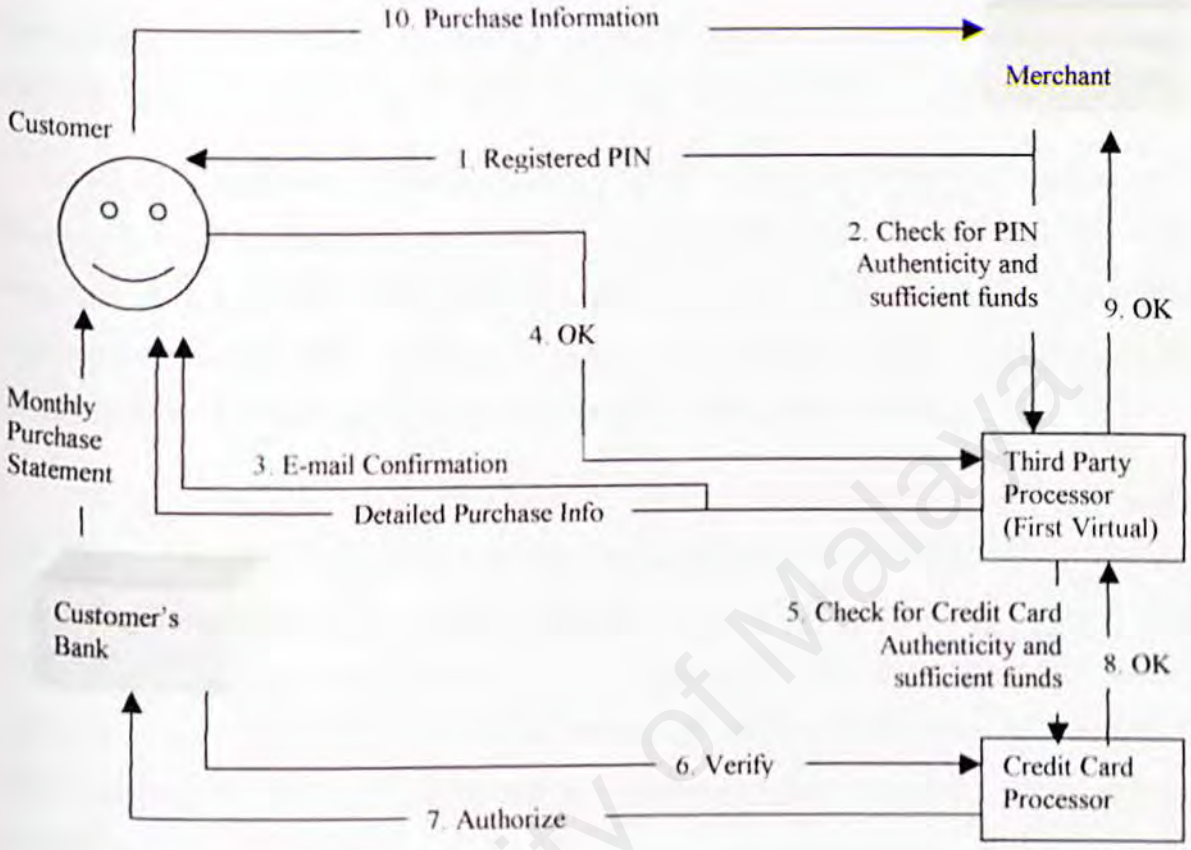


Figure 2.2(b) Online Credit Card Transaction Process (Merchant Receive Payment from Customer)

2.4.5 Hierarchy of Trust

Since both cardholder and merchant are unlikely to use the same bank, they will need a trusted party that can vouch for both banks, which is the card issuer. This has allowed a hierarchy of trust exists in SET transaction environment where is shown below:

Figure 2.3 SET Transaction *(This chart is taken from IBM's site.)*

With SET, cardholders need to install e-wallet on their machines. This is stored and encrypted under a pass phrase that cardholder selects as Is his/her private key, credit card numbers and other information. E-wallet is basically an online version of physical wallets that used by cardholder's Web browser to make SET purchases by interacting with the merchant storefront and POS application. On the other hand, merchants need to install a POS (Point-Of-Sale) software to support their Web servers and electronic storefront applications.

When a cardholder wants to make a purchase, merchant server will send an order to customer browser to open the e-wallet. The e-wallet then asks the cardholder for the pass phrase and exchanges a handshake message with the server. This is to verify if the merchant is authorized to process the card payment while at the same time confirm to the merchant that the customer is the legitimate cardholder for a particular account number.

Next, cardholder sends to merchant a completed order along with payment instructions. The order information and payments instructions are encrypted separately. The order information is encrypted using cardholder's private key, will be visible to the merchant. On the other hand, the payment instruction that encrypted with payment gateway's public key is protected where payment gateway itself alone, can access this payment information. This means that the merchant has no access to the credit card details and thus a source of fraud is eliminated.

The POS software will sends an authorization-request message along with the payment instruction to the payment gateway. Payment gateway is an Internet server run on the merchant's bank to provide access to the legacy-banking network. Payment gateway will check the authenticity and validity of cardholder and merchant certificates to make sure their issuers have not revoked certificates. Then, if the cardholder has enough credits in the bank, the payment gateway will send an authorization-response message to the merchant and at the same time a purchase-response will be send to the corresponding e-wallet. As we can see, for authentication, SSL only traverse on level up, as in chart below:

Trusted CA

|

Merchant

Figure 2.4 Simple Model of SSL

Whereas, SET traverse many levels up to provide cross-authentication, where certificates are issued hierarchically starting with SET root certificate known to all SET software:

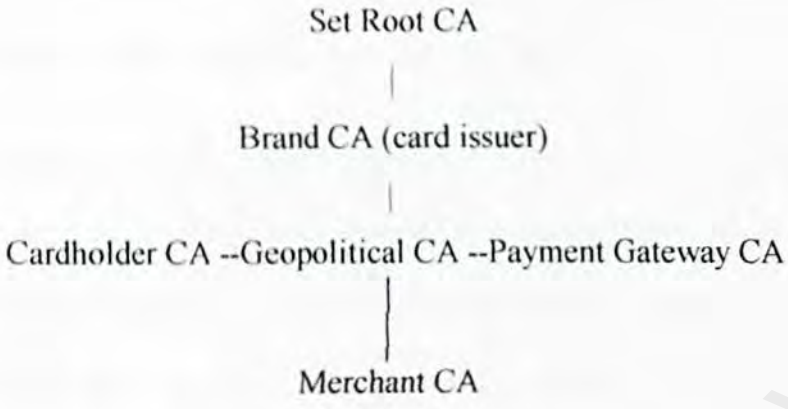


Figure 2.5 Simple Model of SET

Broadly speaking, SET ensures the identities of all parties involved and therefore provides a trusted purchasing environment. However, as more parties need to be trusted, this may reduces the security, as a breach of any four parties in the above example will break down the system security.

Even though both protocols allow for digital certificates, but for SSL, these certificates are optional and can't begin to match the robustness of the SET credentialing system. For example, SSL doesn't have internationally recognized hierarchy of trust as SET provides. Another downside for SSL is that merchants must independently deal with their banks, as there is no interface that connects merchant's bank with cardholder's bank. In addition, as SSL certificates are not tied to a specific credit card account number, they are only serve to identify the machines of all parties involved, but couldn't provides further facilities to complete the sale.

For both SET and SSL, data integrity is guaranteed through encryption. If information is received that will not decrypt properly then the recipient knows that the information has been tampered with during transmission. Due to Department of State restrictions, SSL can use only relative shallow encryption, which only allows 40-bit internationally, 128-bit in the US. However, SET is exempt from the US Cryptography export restrictions and can therefore

use 128-bit encryption for credit card information worldwide. Therefore, undoubtedly SET can provides a stronger encryption for the card information.

2.4.6 The Future of E-commerce Security

An important development need to know is, SET can be used with together with SSL. For example, merchants can use SSL communicating with customers, while using SET on the back end. This sidesteps the need to deploy wallet software to consumers, but captures some of the benefits today. Some SET tool kit and software vendors are moving to support both systems in their products.

2.5 Analysis Of Internet Payment System (IPS)

2.5.1 Review of the Existing Electronic Cash Systems

Ecash of DigiCash [http://www.digicash.com] is the electronic equivalent of real paper cash - a secure payment system for the Internet. Ecash is implemented using public-key cryptography, digital signatures, and blind signatures. This system is focused on the anonymity of electronic cash. This system has disadvantage of centralized management of issuing and checking double spending of coins by one server, First Digital Bank. In this architecture, DigiCash must keep very large database of users and used coins.

This database will grow over time, increasing the cost to detect double spending. Even if the life of a coin is bounded, there is no upper bound on the amount of storage required since the storage requirement depends on the rate at which coins are used, rather than on the number of coins in circulation.

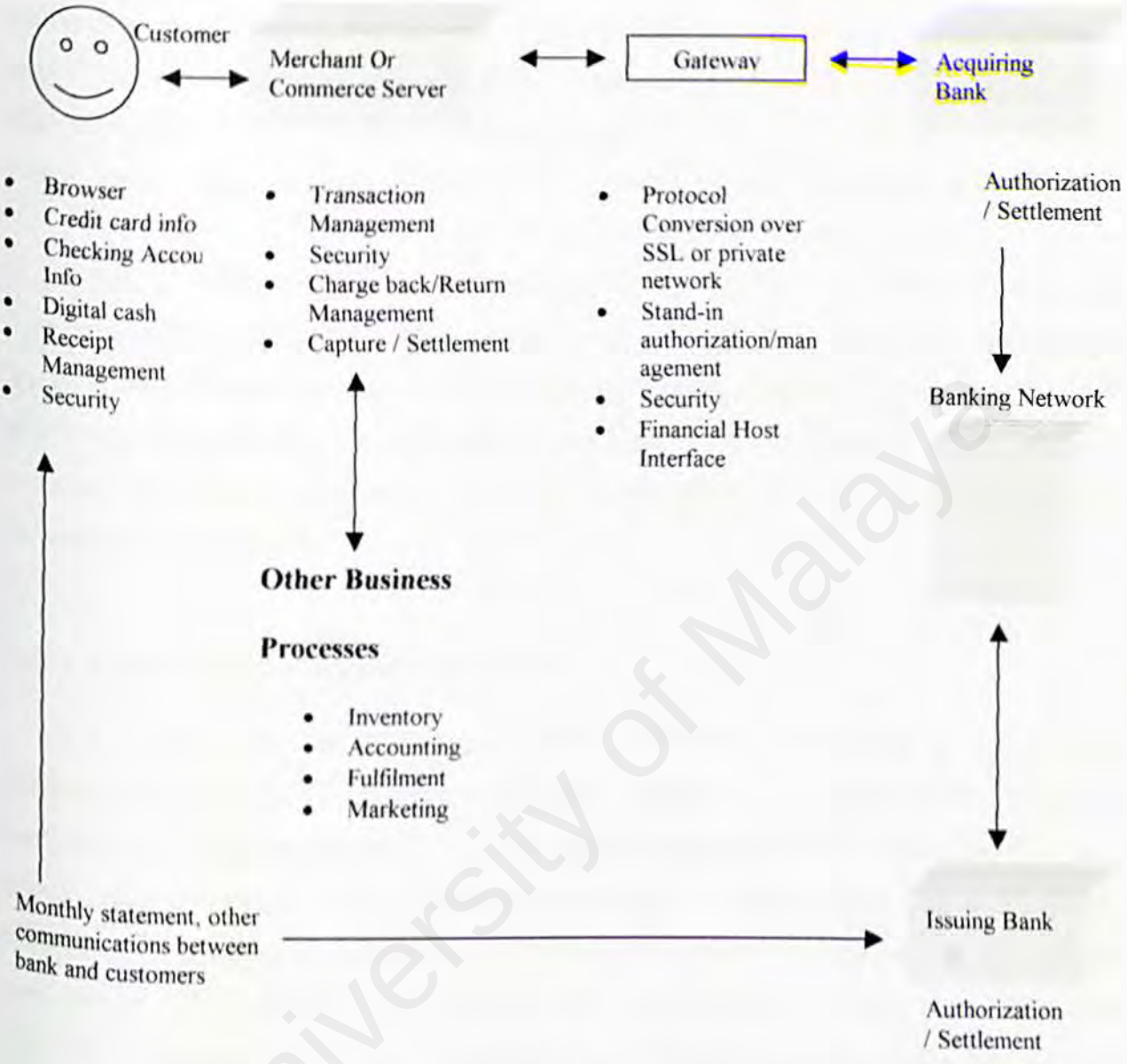


Figure 2.6 Internet Payment System

So, NetCash [http://nii-server.isi.edu/info/NetCash], of USC, proposed multiple currency server architecture. It provides scalability and acceptability with weaker anonymity and only a limited form of offline operation. And NetCash use Kerb Eros for encryption and proxy, a token that allows one to operate with the rights and privileges of the principal that granted the proxy, for authorization. Possible disadvantages of the system are that it uses many session keys and in particular public key session keys. To generate a public key of suitable length to be secure takes a very large amount of time compared with that involved in generating a symmetric session key. This could compromise the performance of the system as a whole.

There are proposed electronic cash systems or protocols like PayMe protocol and Millicent protocol. PayMe protocol is devised with combining two above systems' features. A major goal was to preserve as much of the anonymity provided by Ecash while adopting many of the features of NetCash that allow it to scale to large numbers of users with multiple banks. And PayMe protocol borrows idea of other related systems such as Netbill.

NetBill [http://www.ini.cmu.edu/NETBILL] is the Internet billing system for purchasing information, services, and tangible goods on the Internet. The goals of this system are very low network transaction cost, fully secure authentication and communication, and atomic information transfer. And NetBill system aims to handle hundreds of thousands of customer accounts, tens of thousands of merchants and information providers, and dozens of independent billing servers.

2.5.2 Credit Card Based Systems

A simple model for electronic commerce is to use a credit card to pay for the purchase. First Virtual **(FV)** Holdings [http://www.fv.com] is a payment system to use a credit card to pay for the purchase. FV's main characteristic is that FV uses only WWW and e-mail - no needs of any special software. And there is no security plan. All problems of misbelievery, mispayment, and fraud of unauthorized user are solved by transaction processes of FV's transferring messages between customer and merchant via e-mail. The transaction processed along the FV's definition of electronic commerce transaction flows - The Green Commerce Model.

FV solves the problem that small amount purchasing with credit card is difficult because of high transaction cost of credit card. FV's Green Commerce Server accumulates the small amount payments of customers and transacts those batch. So, FV can decrease the transaction cost for small amount purchasing. CyberCash [http://www.cybercash.com] payment system plans to provides multiple means for users and merchants to move money on the Internet. The CyberCash system is a separate system, which can be used by Andy user, any merchant, and any bank. But now, CyberCash supports only credit card payment and is not yet constructed interface with banks. CyberCash provides user software and keeps user's account on CC server. Both Matercard and VISA announced that they would support a

electronic payment protocol, SET (Secure Electronic Transaction). And they plan to the Internet payment service soon.

The SET protocol has been jointly developed by Visa and MasterCard along with IBM, Netscape, Microsoft, GTE, Verisign, Terisa, and SAIC. Initially, Visa and MasterCard were developing competing protocols, but announced in February that they intended on teaming up to develop and support a single protocol to allow for secure bankcard transactions over open networks. The purpose of the SET protocol, as spelled out in the current Draft, is to use cryptography to provide confidentiality of information, ensure payment integrity, and authenticate both merchants and cardholders.

Both customers and merchants must be set up to support electronic transactions. They do this by registering with a 'Certificate Authority', which in most cases will the cardholder's issuer, or the merchants Acquirer (the financial institution which processes bankcard authorizations and payments for a merchant).

The use of digital signatures, certificates, symmetric keys and asymmetric keys is extensive in this process. In addition, at the end of February, American Express announced their support of SET.

2.5.3 Electronic Check Systems

The ECheck [http://www.fstc.org/projects/echeck/index.shtml] is a electronic commerce project of the Financial Services Technology Consortium (FSTC). The ECheck is modelled on the paper check, except that it is initiated electronically, uses digital signatures for signing and endorsing, and digital certificates to authenticate the payer, the payer's bank and bank account. However, unlike the paper check, through the use of an issuer-defined parameter, the ECheck can resemble other financial payments instruments, such as electronic charge card slips, traveller's checks, or certified checks. It has flexibility. This system uses existing clearing channels as like Automatic Clearing House (ACH) and Electronic Check Presentment (ECP) to clear the ECheck.

NetCheque [http://nii.isi.edu/info/netcheque] is an electronic check system for the Internet developed at the Information Sciences Institute of the University of Southern California. Signatures on checks are authenticated using Kerb Eros. Using multiple accounting servers provides reliability and scalability. NetCheque is well suited for clearing micro payments; its use of conventional cryptography makes it more efficient than systems based on public key cryptography. This system will couple with NetCash system.

2.5.4 Electronic Funds Transfer Systems (EFTS)

Security First Network Bank (SFNB) [http://www.sfnb.com] is the first bank that opened on the Internet and services the conventional bank's full service. As a banking service, SFNB provides EFT using the WWW. If a payer inputs payment amount and payee on the web, then the amount is debited to payer's account and payee can receives the amount. If a payee does not accept electronic payment, SFNB writes a check from payer's check book and mails it to the payee. But, this process needs process time of 2 -3 days.

2.5.5 Weaknesses of Current Payment Methods

In spite of that the currency and banking systems progress extremely, there are some weaknesses of current payment methods, in present days. These weaknesses provide good opportunities of developing a new payment method. In the Internet electronic commerce, it can be more radically "new" because many weaknesses can be eliminated owing to this environment.

Cash handling cost is very high. In fact, cash has almost zero transaction cost, but has high handling cost. There is no cost to give some money from one's wallet and to take it into the other's wallet or the cash box. But, it is spent enormous cost to mint, transfer, distribute, store, and even tear to disuse.

Another weakness of cash is inconvenience of handling. If one must make a large amount payment, he will not use cash. For example, to make a 10 millions won payment, he must carry a thousand of ten thousands paper notes in a box or a trunk. It is very troublesome work.

Limitation on payment amount range is very narrow. A credit card cannot be used in very small or very large amount payment. The reasons of these are two. First, high transaction cost of credit card is the reason of lower bound. If one pay 500 won for a good and the transaction cost of this payment is 300 won, no man will use this. Second, the effort to reduce risk of credit card organization is the reason of the upper bound.

Credit card payment requires only information on the card face such as credit card number, expiration date, and name on card. There is no need to input password to buy a cloth or a compact disk in the shop. So, it is easy to use the other's credit card in malice purpose. The exposure of credit card information to anyone who has mille is very critical.

First, process of using checks or notes is very complex. There are too many related laws and regulations for a general user to use a check or a note. There are many reasons and possibilities of occurrence of a dishonoured check and note. Users of a check and a note are conflicted by the complex procedures. There has frequently occurred misdealing of those methods. Moreover, the procedures and related laws and regulations of each payment methods are all different. If a user wants to make payments by multiple payment methods, he must know much about those payment methods. It is very difficult for a general user.

Main weakness of current payment methods is high transaction cost. Transaction (handling) cost of cash is high, not to speak of those of a credit card, a check, and a note are high, because the dealing procedures of those payment methods are very complex. So, making payment and settlement of those methods has pretty high fee to user.

Risks and limitations on payment amount of each method are also weaknesses of current payment methods. Paul-Andre' Pays and Fabrice de Comarmond (1996) list up requirements for both the merchants and the customers concerning electronic commerce.

2.5.6 Comparing Current Payment Methods

The factors of payment methods are defined as follows. According to these factors, several current payment methods are compared. Current payment methods those are analysed

are cash, EFT, debit cards, credit cards, checks, and notes. The factors describe clearing time and risks of payment methods, mainly.

- Payment due: The time of clearing and updating the payer's and the payee's accounts after a payer makes a payment. In the case of EFT, clearing between the payer's and the payee's banks is performed on the next day, but updating is performed simultaneous with payer's making payment.
- Anonymity: Only payment using cash is protecting privacy. The transaction of the method that supports anonymity protects privacy.
- Control on issuing: This factor describes who has the major control power of issuing.
- Number of endorsers: Endorsing is a means of certificating authentication of a payer and a payee. In the case of a note, multiple endorsing and circulation is permitted.
- Payer's source of authentication: This factor describes what certificates authentication of a payer.
- Guarantee: This factor describes who guarantees payer's non-payment or misprocessed payment.
- Risk of payee: This factor describes whether the risk of the payer's non-payment is imposed to the payee. Even though a payee can recover all values to be paid ultimately, the method is risky because that procedure is very complex.

Circulation: This factor describes whether the payment media is permitted circulation.

2.6 The Considerations of Gateway, Interface and Connectivity in E-Commerce Applications

Information Gateway Services (IGS) is an Internet Service Provider, which operates in 18 locations across Canada. IGS Offers a range of services for both private individuals and corporate or business customers, including dialup Internet access, Web page hosting, virtual Web, Mail and FTP services, Web page design and CGI scripting.

2.6.1 Internet Server Application Program Interface (ISAPI)

Process Software developed ISAPI [7] in collaboration with Microsoft Corporation and other Web server vendors. ISAPI is a high-performance, scalable solution for developers who want to create dynamic Web sites. These sites have to be able to handle high request rates without degrading the HTTP server's performance.

There are a number of compelling reasons to use ISAPI. ISAPI is not simply a better CGI [7]. ISAPI is different from CGI and was designed to solve the problems of CGI. First, ISAPI scales much better than CGI. ISAPI dynamic-link libraries (DLLs) need fewer resources such as server memory than CGI. This means that your server can handle more concurrent requests under ISAPI than a Web site can using CGI. ISAPI is also faster than CGI. ISAPI allows you to write extensions to the server that can outperform their CGI counterparts by as much as five times.

Finally, ISAPI allows you to extend a Web server in ways that Web server vendors may not have envisioned. ISAPI gives much more control over an HTTP connection than CGI can. It does this by providing events that an ISAPI filter handles in each step of processing during an HTTP connection.

ISAPI allows you to build Web sites that scale up from one connection to hundreds of concurrent connections per second without massive additional resources such as server memory. Until ISAPI came along, the answer to better CGI performance was to throw more memory at the Web server until the Web server stopped memory swaps to the disk.

CGI works by creating a new process for each CGI request. The Web server responds to a CGI request by creating a new process, filling that process' environment with HTTP request variables, and starting the CGI application. The memory needs of concurrent processes can rise quickly. ISAPI applications, on the other hand, do not need to create a new process. The ISAPI server simply creates a thread pool when the server is initialised.

Creating a thread take much less memory than creating a new process. A free thread from this thread pool serves the incoming connection. If the threads in the thread pool are all in use, the server can create additional threads to handle the waiting connections. Thread creation is much faster than process creation. The server must also track new CGI applications while they are running. The server may even need to do some cleanup after the application ends.

With ISAPI, the server calls the ISAPI DLL's entry point and leaves processing up to the extension or filter. Once processing is complete, the ISAPI DLL does any necessary cleanup and returns control of the thread to the server.

2.6.2 Common Gateway Interface (CGI) Versus Web Server APIs

The Common Gateway Interface (CGI) was introduced as a standard protocol for extending the functionality of Web servers with additional applications. Most CGI applications are simple executables that are launched every time they are requested. ColdFusion uses a more robust architecture. The ColdFusion Application Server runs as a multi-threaded system service and handles all of the complicated processing. The Application Server communicates with the Web server either through a very small CGI executable referred to as the stub (cfml.exe) or through a native Web server API.

As Web servers have developed, each vendor has introduced and implemented an application-programming interface (API) for their server. The native Web server APIs offer additional features and significantly increased performance. Instead of launching a CGI executable, servers supporting an API communicate directly with the ColdFusion apparently with the ColdFusion application.

In addition to introducing server APIs, many server vendors have created document type mapping, so that individual document extensions can be associated with a process. This makes it possible to create ColdFusion application pages that are stored directly in the Web server's root directory. ColdFusion supports the following major native Web server APIs:

- Netscape API (NSAPI)
- Internet Server API (ISAPI)
- Website API (WSAPI)
- Apache API - These servers support these APIs and document type mapping:
- Netscape Enterprise and FastTrack Servers
- Microsoft IIS (all versions)
- WebSite (1.1 and Pro)
- Apache

Chapter 3

System Analysis and Methodology

3.0 System Analysis and Methodology

3.1. Introduction

An effective development method and design must be chosen in order to make the project development are done on the time within effort. There are no one right way to develop a system, each development method had it own strength, depending on the situations they are used, the way they are applied and who involved in the development process. The different of system process decomposes these activities in different ways.

However, some process methods are more suitable than others for some type of system or application. It the wrong method chosen, it will probably reduce the quality or the usefulness of the system to be developed. Therefore, this chapter will give details to the quality of proposed software tools and methods for the system implementation. This chapter will also identify the methodology, mechanism and approach to be adapter.

The constraining requirements, which will be, discuss later, will be identified to limit the space and possible design option. They are characteristic within the user development and application environment that preclude certain solutions to the design problem. Also with the concept of model used, it develops an very understanding of the overall system functionality.

Besides, this chapter are including functional requirements and non-functional requirements, which the functional requirements are categorized and identified for each phase of the system development. For the non-functional requirements, they must be met by deliverables.

3.2. Systems Development Life Cycle (SDLC)

SDLC is classically thought of as the set of activities that analysts, designers and users carry out to develop and implement a system. In the others words, the SDLC is a phased approach to analysis and design which holds that systems are best through the use of a specified cycle of analyst and user activities.

This method consist of seven different phases:

- Identifying problems, opportunities and objectives
- Determination of system requirements
- Analyzing system needs
- Designing the recommended system
- Development and documenting software
- Testing and maintaining the system
- Implementing and evaluating the system

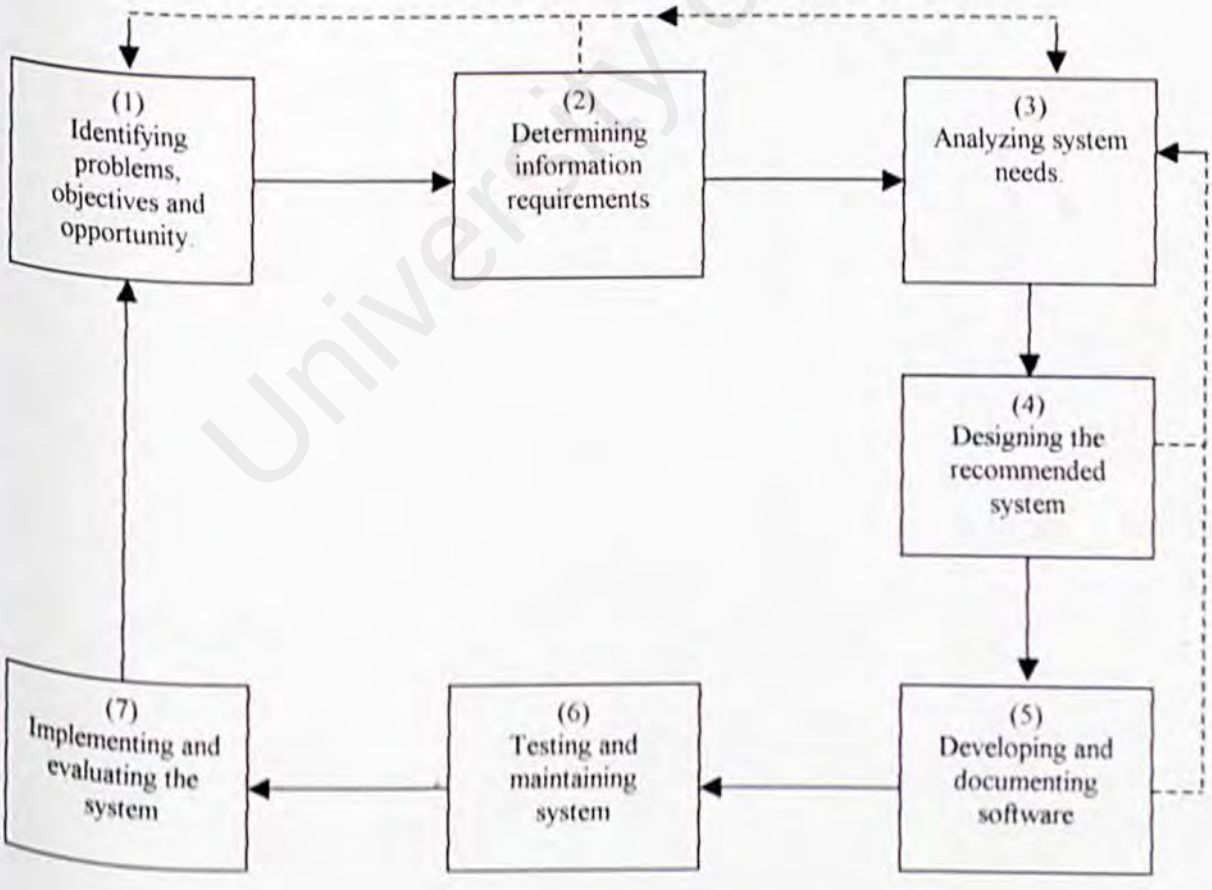


Figure 3.1 The seven phases of SDLC

There are many reasons of considering the SDLC for a system development application:

- To form a common understanding of the activities, resources and constraints involved.
- To find inconsistencies, redundancies and omissions in the process and its constituents parts. As these problems are noted and corrected, the process becomes effective and focused on building the final product.
- To reflect the goals of development, such as building high-quality software, findings early in development and required budget and schedule constraints.
- To understand what process should be tailored for the special situation.

3.3. The Basic Requirements Of System Development

This section is mentioning about the application domain or the user environment that limit the design possibilities and force certain decisions, which will be taken on it.

3.3.1 Hardware Architecture

This architecture is very important to develop the system. Many components of the hardware will be considered properly to make the system developed be more efficient and powerful. Therefore, the table shown below are considered as hardware configurations to be choose for developing the system:

Components	Descriptions
Microprocessor	AMD K6/2 – 350 MHz and above
RAM	32.0 MB of Memory and above
Storage	4.2 MB of Hard Disk or more
Input Devices	1. Mouse
	2. Keyboard
	3. Scanner
Output Devices	Printer
Monitor Interface	VGA compatible display

Figure 3.2 The hardware used in developing the system

3.3.2. Operating System

Nowadays, there are several Operating Systems(OSs) that are available which can suit our needs and meet the requirement. The OSs include Windows, LINUX, UNIX, Macintosh (for Apple computers only) and OS/2. However all of the OSs that supports the current hardware components is limited.

3.3.2.1. Windows 98

Windows 98 is a product of Microsoft Corporation and is used widely as the Operating System in Personal Computers today. Windows 98 also will be used as client(s) that can be connected to the Windows NT Server [9] in the Software Engineering Laboratory in this project. There is not a problem to prevent the other OSs to be able to use the system because it depends on the Web browsers to visit the Web site and conduct the transaction.

3.3.2.2. Windows 2000 as System Development OS and Web Server

This system will be developed by using Windows 2000 Professional Version with hardware configurations as mentioned at section 3.3.1 (Hardware Architecture) above. Window 2000 will be chosen as the operating system due to several advantages that are distinct when compared to other operating systems. Below are the reasons why it has been chosen over the other operating system.

- Dominant Position

One of the main reasons for choosing this operating system is that Windows currently enjoys a dominant position as the preferred network operating system by most corporations. In the consumer market, Microsoft's Windows enjoys a penetration rate of almost 90% of the overall market, which makes it almost the *de facto* choice for operating system.

- User Friendly Environment

Windows 2000 server support multitasking and it is also extremely user-friendly. Furthermore, the user interface of Windows 2000 server is very similar to Windows 95 or Windows 98. Therefore, users have no difficulty in adopting to Windows 2000 server. This is unlike Unix, where the tasks are performed by command scripts. New users have difficulty in learning these commands. Time is wasted to learn the commands just to perform a certain task. Moreover, Window 2000 Server is a networking operating system to help developers build and deploy business application faster than ever before. New management tools in Windows 2000 includes helps to set

up web-site, simplify access to resources, manage contents and analyze usage patterns. These reduce the cost of building a server.

- Ease of Installation

Installing Windows 2000 does not present much difficulty. However, UNIX involve complicated installation procedures. For example, each UNIX machine has their different documented installation procedure. Prior to each installations, the source code (kernel) needs to be complied.

- Developments Tools

Various development tools have been created for Windows users. Some of these have helped to speed up the software development process. Furthermore, many applications tools adopting the visual programming method like Visual Interdev, Visual Basic, Front Page and so on. Visual programming is useful in cutting the time spent on the program coding.

- Availability of Technical Support

Another plus for Windows user with the Microsoft offices around the world, Windows users are accessible to customer supports when a problem is encountered and they could not fine decent solution for it. This provides more confidence to customer using Microsoft products.

- Skilled Professional

Microsoft boasts of extensive resources of skilled professional as its produce are widely used. However, UNIX does not have as many skilled development and support professionals. This will inherently increase the cost of developing and maintaining the system as the shortage of professional leads to competition.

Windows 2000 server also supports for innovative web publishing features, customize tools and new wizard technologies makes it the best platform available to publish information over the Internet especially in this proposed system.

3.3.3 Web Application Programming

3.3.3.1. Active Server Pages (ASP)

ASP is chosen as the web application programming technology because it is more suitable and be able to use for a good online directory system development [10]. The more concurrent requests there are, the more concurrent processes created by the server. However, creating a process for every request is time consuming and requires large amount of server RAM.

In addition, this can restrict the resources available for sharing the server applications itself, slowing down performance, and increasing wait times on the web. ASP instead runs in the same process as the web server, more handling client request faster and more efficiently. It is much easier to develop dynamic content and web application with ASP.

ASP is chosen over the other applications because most of them are not available for all server platforms. For example, support for Linux will be available only with the upcoming release. This will be the constraint for the system. There are several additional features with ASP:

- ASP provides a familiar framework and objects for building complex applications that require data from relational databases and legacy sources.

- ASP is an easier way for server to access information in a form not readable by the client (such as SQL database) and then act as a gateway between the two produces information that the client can view and use.

- ASP enables dynamic web design to be easier. This feature makes the web applications easy to maintain and modify to meet the new needs and requirements.

- Scalability. ASP is suitable for Electronic Notice System to conduct its tasks over the Internet where have a lots of potential users.

- It provides easy access to databases through Active Data Object (ADO) that is the new database object model [11].

3.3.3.2 Web Scripting Language

Server Side Scripting Language

VB Script [12] has been chosen over the Java Script as the server side language in implementing this online directory system. It is due to the reason that ASP was chosen as the technology to develop the system. Many resources and data are going sample of code in VB Script while coding with ASP. Besides that, as the scripting is run on the server and the server streams back the required HTML the client browser is not an issue so can safely use VBScript. The other reasons that have been considered are:

- It is easy to learn and write the application programs compare to JavaScript. VBScript is based on the easy-to-learn BASIC (Beginner's All Purposes Symbolic Instruction Code). This is important because project time frame should always be considered to make sure the system would be completed on time

- It is a fast, portable, lightweight interpreter for use in World Wide Web browsers and other web applications.

- It is powerful and it can be used to develop interactive client side web pages. Besides, it also tightly integrates server-side application.

Client Side Scripting Language

The selection was done between Java Script [12] and VB Script for the client side scripting. Java Script undoubtedly remained a firm choice as all major browser such as Microsoft Internet Explorer or Netscape Navigator could understand Java Script. VB Script can only be viewed with Internet Explorer, if the user uses another

browsers are unable to fully utilize the web page as the code in VB Script would be skipped.

3.3.4 Data Access For Active Server Pages (ASP)

3.3.4.1 ActiveX Controls

ActiveX is the new corporate slogan of Microsoft in a very short time, has come to mean much more than "Activate the Internet." ActiveX represents Internet and applications integration strategies. These days, products and companies that don't have ActiveX and Internet somewhere in their nomenclature are considered, both internally and externally, as being behind the times. The reality is that trying to describe ActiveX is similar to trying to describe the color red. ActiveX is not a technology or even architecture--it is a concept and a direction.

ActiveX Controls is a self-contained program (or component), written in a language such as C++ or Visual Basic. When added to a web page, an ActiveX control provides a specific piece of client-side functionality, such as a bar chart and graph, timer, client authentication, or database access. ActiveX controls are added to HTML pages via the <OBJECT> tag, which is now part of the HTML [5] standard. The browser can execute ActiveX controls when they are embedded in a web page.

ActiveX controls despite being compatible with the HTML standard, they are not supported on any Netscape browser prior to version 5 without an ActiveX plug-in. without this, they will only function on Internet Explorer, although there are plug-ins available if this system wants ActiveX functionality with Netscape browsers.

3.3.4.2 Object Database: ActiveX Data Objects (ADO) and Data Access Objects (DAO)

ADO [11] is designed as a replacement for DAO. DAO is Microsoft's first object structure/code library to manipulate databases. Many DAO commands that have been retained for backward compatibility can make the syntax quite ugly at

times. DAO code assumes database is local and while it can deal with ODBC data (Oracle, DB2, SQL Server, Paradox, FoxPro) it has no special facilities for dealing with the data. It would not break with non-local data, but can not get certain things that make sense with remote data done.

VBScript supports a wide range of *ADO* [11] objects (ADO for *ActiveX Data Objects).* Because these objects are ActiveX-based, they work across different platforms and programming languages (unlike the data control, which works strictly in the Visual Basic environment). The ADO objects support database access both for local as well as remote data objects (known as *RDO).* Remote data can come from across a network or a communications line.

ADO controls is important because they offer several advantages over the data control. Despite the background necessary to work with the ADO controls, they are the current choice among the database programmers due to their power and flexibility.

ADO technology supports faster database access than the data control does. Although today's computers run quickly, the system will produce high speed degradation when the data control for large database tables is used, especially ODBC-based databases.

Perhaps the most important advantage of ADO is its capability to access many kinds of data. Not limited to just relational and nonrelational database information, ADO control can access, through advanced programming, Internet browsers, email text, and even graphics.

If leave a reference to the ADO Object Library in database, then the program will need to take care when declaring Objects that belong to both Object Libraries, such as Recordset:

```
Dim rsADO as ADODB.Recordset
Dim rsADO as ADODB.Recordset

Conn.Open                    "...",                    "...",                    "..."
'                                                ^DSN                    ^User ^Password
Set    RS    =    Conn.Execute(    "SELECT    *    FROM    theTable"    )
```

Else, access will probably allocate the Object to the highest ranked reference, with possibly unexpected results. So the best thing to do is to play it safe, and tell Access that it does belong to a certain Library.

3.3.5 Software Development Tools

3.3.5.1 Microsoft Visual InterDev 6.0

Microsoft Visual InterDev comes as part of Microsoft suite of professional programming tools, known as Visual Studio. Visual InterDev is a tool developing dynamic web applications. It is a development environment and a collection of useful tools and utilities.

Visual InterDev is the tool that Microsoft promoting as their favoured ASP editing tool. One simple but useful feature of Visual InterDev is that it highlights ASP <% and %> tags in yellow, and the ASP script itself is highlighted using blue for legal keyword. So they stand out from HTML [13].

There are three possible views of web pages:

- The Design View, is WYSIWYG interface. This allows users to put together a web page in much the same way as when creating a document in the Microsoft Word. Picture, links, sound can be inserted without having to write a single line of HTML.

- The Source View, the HTML generated by any works that have been done in the design view can be seen.

- The Quick View tab, to preview the HTML pages in advance.

The Design and the Quick View are not able to process ASP. Both are limited to viewing HTML only. However, if the ASP file in the Source View contained within a project, there's an ASP-friendly alternative. We can select the *View* in Browse to see what the processed ASP will look like.

In addition, Visual InterDev boasts strong links with SQL server, which makes it very easy to setup database combining ASP and SQL Server. It also provides several useful web-based tools for doing things like checking links, highlighting the broken ones on your site and allowing us to drag and drop pages form one location to the another.

Visual InterDev does not have a compile of drawbacks. It is the most difficult to master of the editors discussed here. But having said that, it's undoubtedly the most powerful of these editors as it offers many tools and features to the developer.

3.3.5.2 Microsoft FrontPage 2000

Microsoft Front Page is the other tool for creating and designing web pages, but it doesn't offer all the functionality of Visual InterDev.

It's ultimately a weaker but easier application to use. It offers three views of web page. The *Normal* tab gives a WYSIWYG (what you see is what you get) page creation view, *HTML* tab allows user or developer to write and modify code explicitly. The markup of a web page is provided by system, user can directly do page creation. In the *Preview* tab, it gives a quick view of what the page should look like in browser.

3.3.5.3 Microsoft SQL Server

Due to the reason that the proposed is not an independent single desktop system, Microsoft SQL Server is the best choice as the web database for the development of this system if compare with Microsoft Access. Microsoft SQL Server incorporates a world-class feature set for distributed client/ server computing.

Microsoft SQL Server is chosen over Microsoft Access. Although Microsoft Access is easier relatively, but it is considered a lower level database which is not suitable for the proposed system.

The others using SQL Server will see benefits in the following key areas:

- Reliable distributed data and transactions
- Centralized control of distributed servers
- Very high performance and scalability
- Support for very large databases
- Full programmability and standards support
- Rich desktop integration
- Open interoperability

3.3.5.4 Other Related Software Tools

There are some other useful software tools not only used to develop the system but also used to do some documentation about the system especially in designing the program data flow and user interface.

Visio 2000 Professional:
Design a better program data flow for the system so that the system developed become more powerful and efficient to be used.

Adobe Photoshop 6.0:
Produce many attractive images to add into the Web pages which can attract as many as many users to stay at the website. It also can create certain images as icons to represent the functions or the Web pages that can be linked.

Animation Shop:
Create Graphics Interchange Format (GIF) images. GIF images will show the animation of some Joint Photographic Experts Group (JPEG) images such as the product pictures of the company and etcetera, which the company can make

advertisement on it's website. These two format of images are selected because their size are very small and can make the process of loading of the website be more faster.

Macromedia Flash: A multimedia software which can create animations of images, export high quality images and simple multimedia show that can be published on the website as advertisement or other use.

3.4 User Requirements Specification and Analysis

3.4.1 Functional Requirements Analysis

The functional requirements are incremental development to the preliminary requirement analysis as mentioned in front. They are categorized and identified for each phase of the system development. The project will involved three events:

3.4.1.1 Ordering and Logistics

Purchase orders are placed and processed.

a). Develop server-side application to process the request from the consumers. Log each successful purchase session and other related information in the Log database in Microsoft SQL Server 7.0.

b). Develop a form inquiring the consumers to fill. Information like address and telephone number would be asked in order for the goods to be delivered. Invoices and receipts (after payment has been made) are generated and send to the consumers either electronically or manually.

3.4.1.2 Contractual

Concerned with gathering of information about the products being sought, and the discovery of the sources of supply.

a). Design and develop a relational database to store the products information, transaction information, session information.

b). Understand the ordering processing methodology. Develop secure Web application with SSL 3.0 protocol. Secure the Web server with NT security and configure the US Web server to control files and protect the programs. A formal relationship between

buyer (consumer) and seller (company) is created, including the establishment of the terms and conditions to apply to transactions under the contract.

c). Develop the client-side applications (ASP) using Visual InterDev 6.0. The DHTML pages and HTML pages will be generated to guide consumers' shopping and purchasing. The interface design is not a prime concern as this project's main objective is to deploy a secure online transaction using MSK. So, before the digital signature is signed, the SSL connection between the Web server and Web browser by consumer) must be established. The request will be done by HTTPS protocol.

d). Develop a Web browser plug-in (WebSigner) to sign the digital signature to be passed to the Web server. The consumers must have their own security tokens before using the MSK. The plug-in embedded in the <EMBED> tag in the HTML/DHTML pages. Users will be asked for PIN number to sign the digital signature which is contain in the smart card and read by the smart card reader. The digital signature signing status will be displayed on the status bar of the sign dialog box.

3.4.1.3 Payment Transaction

This involves the digital payment system mentioned earlier, Virtual Internet Payment System.

a). A small function module to act as the acquiring bank for the company to credit the amount of the purchases made by consumers. A relational database can be built to store the company's information and the policies.

b). Another small function module to act as the consumers' bank to interact with the acquiring bank for the transaction of the payment.

c). The modules will be able to duel with the reverse and charge back of the product.

3.4.2. Non-functional Requirement

The non-functional requirements, which must also be considered. The following sections supplement the requirements analysis mentioned above.

The server should response in a reasonable time when there are multiple accesses to the Web server. No compromise to the, security should be made to any forms of retrieving the private and confidential data inside the database. Web server should not allow any access to the unauthorized users for administration purpose. Any background processing are killed before the SV EXE server program is launched to give the system more memory resources and to avoid the conflict of the system.

Some attributes also been included in this requirement, they are availability, maintainability, transferability/conversion, and reliability:

- **Availability:**
  The consumers are able to view the contents of the Web site and purchase the goods when the Web server is running. When the Web server is turnoff or down, the system service will be terminated temporary.

- **Maintainability:**
  Database maintainability must be scheduled and optimized from time to time. The design of the database is crucial to enable future development to the transaction log database. Scheduled tasks involved organising and removing /filtering outdated or closed Order placement in which payments fail. The transaction log database has scheduled tasks that must be run by the MS SQL Executive to perform maintenance on the transaction details store and backup the database. This schedule can be modified to customize whenever there is a need to do so. The server-side and client-side applications can be added and modified from time to time. The enhancement must consider taxation and additional fees (service charge) and other considerations for shipping the product from different vendors or business subsidiaries.

- **Transferability/Conversion:**

  The system will run only on Windows NT 4.0 Server. Nevertheless, the system can be integrated to another platform by deploying some kinds of integration techniques. Examples of possible platforms are LINUX and UNIX. However, the compatibility of the software is the main concern.

- **Reliability:**

  The system will be accessed and the reliability is measured.

Chapter 4

System Design

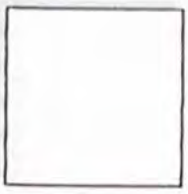
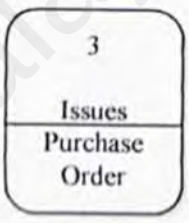
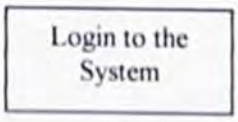
4.0 System Design

4.1 System Design Method

The system design is shown by using some diagrams, which are drawn to make the system flow become more understandable. The design phase is the stage to translate the requirements into the module characteristics. System design shown here is to give an overall of how the system works because a proper design is a must to make sure that the system work properly.

The design is based on data flow oriented or structured design that stress on modularity and top down methodology design. The system flow is depicted in the flowchart model while the data flow is depicted in the data-flow model. In the Data Flow Diagram (DFD), functional transformations process their inputs and produce outputs. As data flows from one numbered process to another, it is transformed as it moves.

Data Flow Diagramming is a means of representing a system at any level of detail with a graphic network of symbols showing data flows, data stores, data processes, and data sources or destinations. The data flow diagram is analogous to a road map. It is a network model of all possibilities with different detail shown on different hierarchical levels. The process of representing different detail levels is called "levelling" or "partitioning" by some data flow diagram advocates. The symbols used in the flowchart and DFD are shown in table below [8]:

Symbols	Meaning	Example
	Entity	
	Flow of Data	
	Process	
	Data Store	
	Terminator (Used in Program Data Flow)	
	Process (Used in Program Data Flow)	
	Decision (Used in Program Data Flow)	

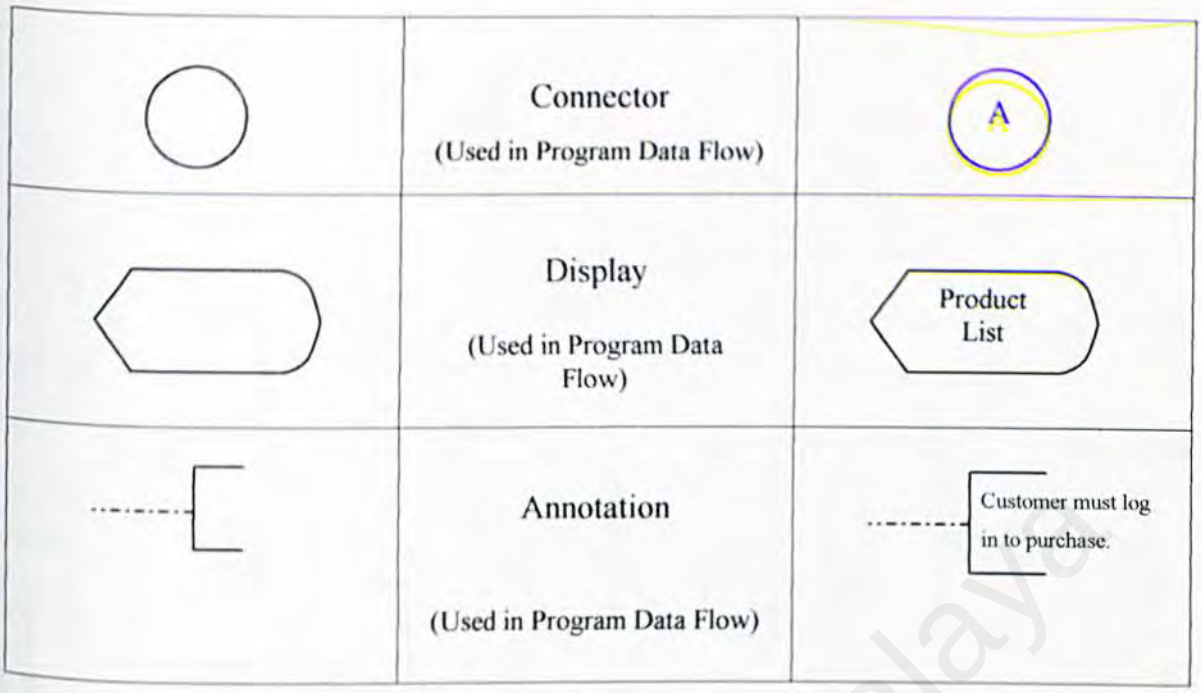


Figure 4.1 The Basic Symbols Used in Drawing The DFD

By using these symbols, this system is designed as shown in Figure 4.2.

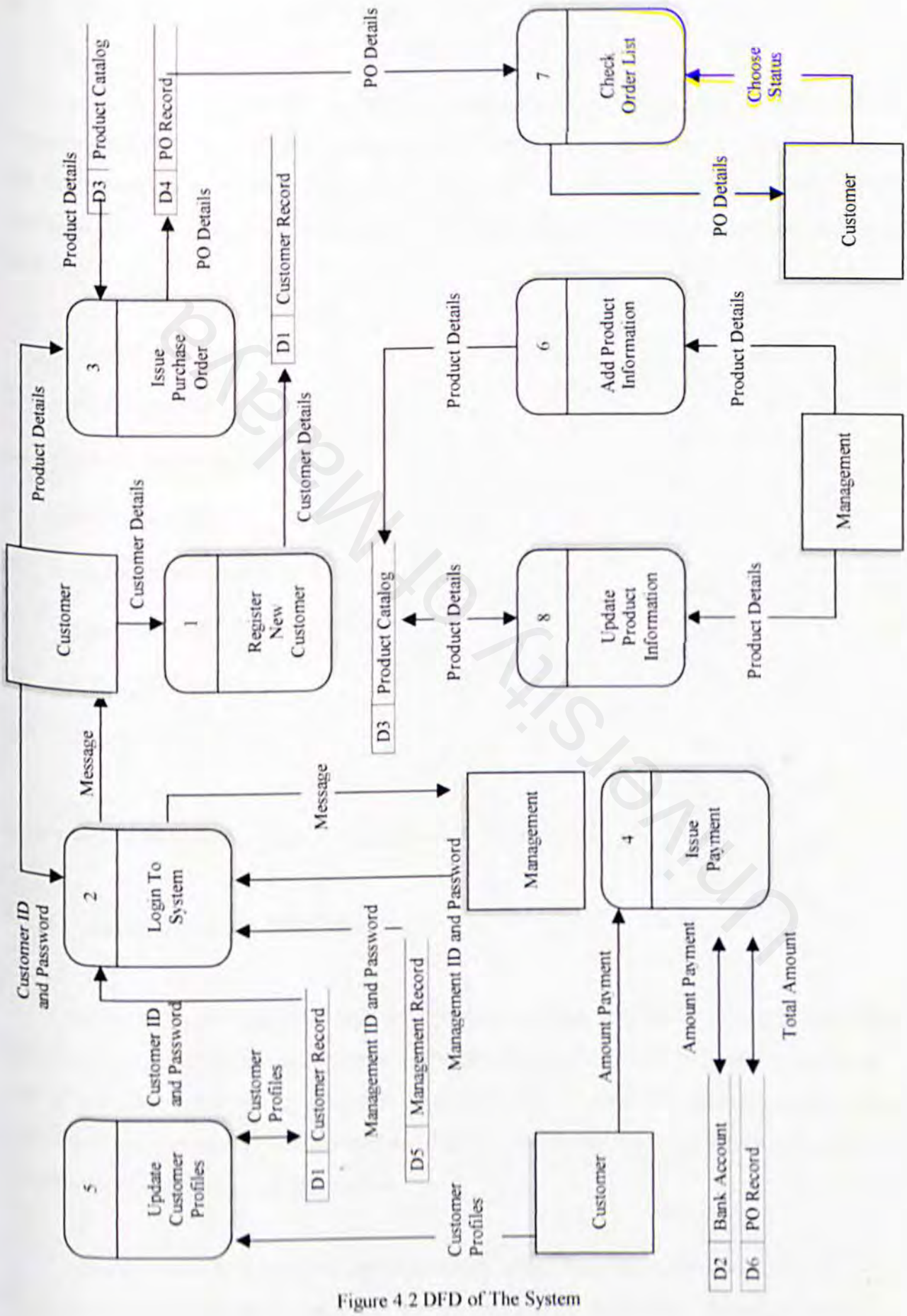


Figure 4.2 DFD of The System

4.2. System Module Design

Module is a standard or unit of measurement or is a standardized, often interchangeable component of a system or construction that is designed for easy assembly and flexible use. The online inventory control system is divided into modules to ensure the systematic and efficiency of development. The system is divided into 8 separate modules, these include:

i) Registration Module

ii) System Login Module

iii) Purchase Order Module

iv) Payment Module

v) Customer Update Module

vi) Check Order List Module

vii) Add Product Module

viii) Update Product Module

Some simple explanations Program Data Flow are shown below:

4.2.1 Registration Module

Every user who start browsing the company website will make a tour in the web pages created to find out the information of the products provided. If they want to make the issue of purchase order, the system will request the user to make a registration as a new customer of the company. This registration process can get and store the information of the customer so that a business will be started.

After the user finish to fill up the registration form, the system will check whether the form is completed or filled correctly. The system will request the user to check back the form

if there are any errors or invalid entry of the form. Finally, a unique customer code will be auto-generated for the customer to use every purchase order that they are going do next. *(See Figure 4.3)*

4.2.2 System Login Module

Customer Login

Once the user was registered as a customer, he can login in to the system and make the issue purchase order. Customers are required to enter their username and password for the system login. Their login information will be checked to identify the validation of the customers. The password entered is encrypted to enhance the security for the system, so that those customer will be more confidence to continue purchasing product or other activities like update their profiles over the website. Password changes are always available for customer. *(See Figure 4.4)*

Management Login

Management part has to login to the system before choosing their activities over the system. They are using the same interfaces, which is used by the customers. The management person acts as an administrator to update latest product so that the customers will always provided with updated products. *(See Figure 4.4)*

4.2.3 Purchase Order Module

After login to the system, customers can continue making their issue of purchase order. They can view the information of products by choosing the product type of the products provided. They can easily achieve the products details from the database and decide which products to be purchased. After making decision to purchase products, the total price of the product will be calculated and stored in the database. Next, they have to make their payment whether within two weeks long or straight away pay for their products purchased. *(See Figure 4.5)*

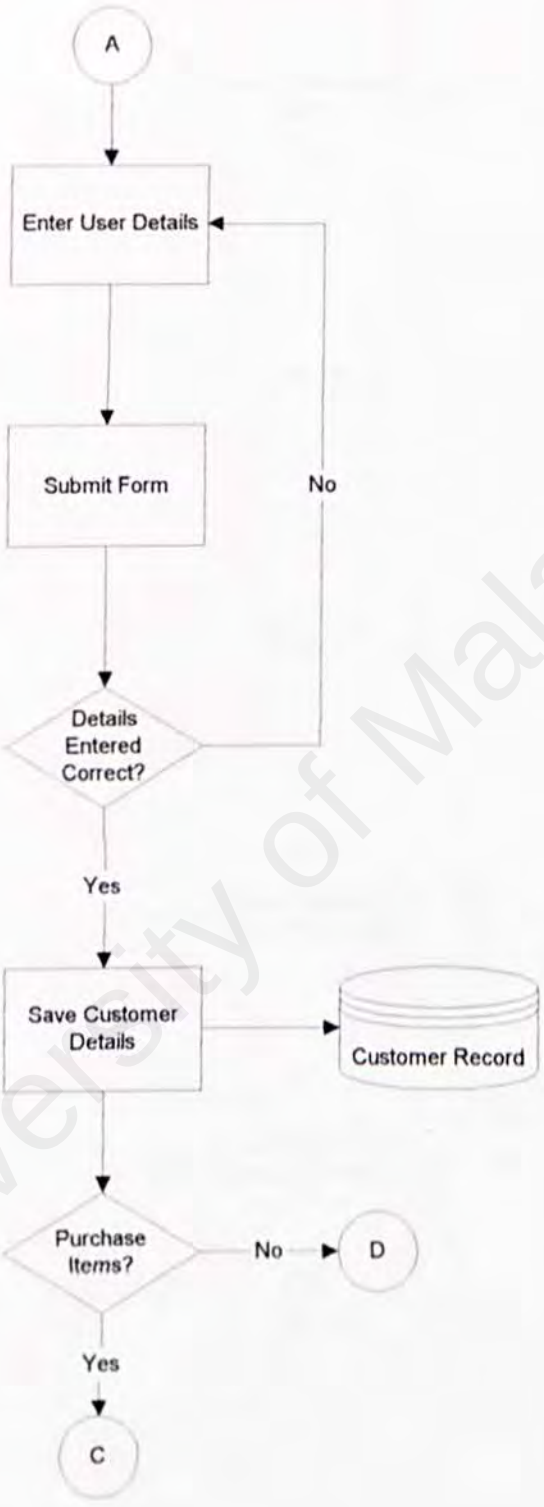


Figure 4.3 Customer Registration

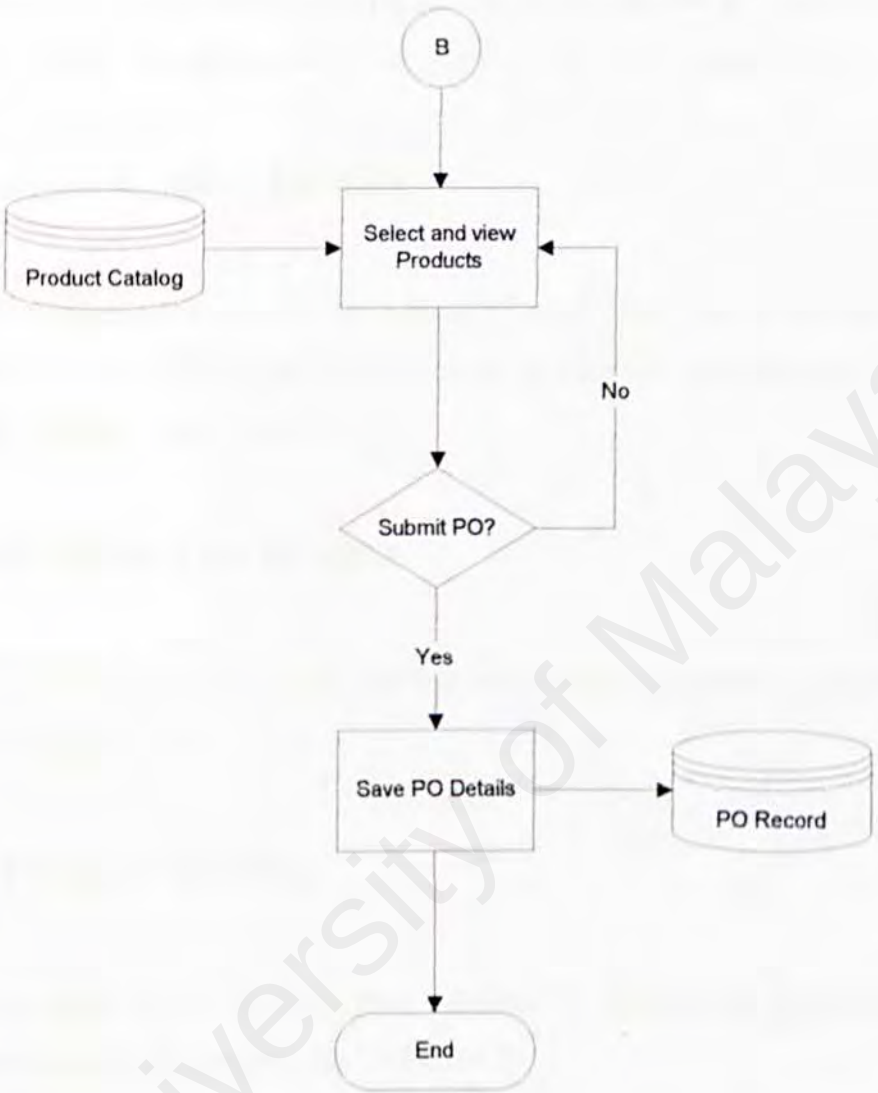


Figure 4.5 Issue Purchase Order

4.2.4 Payment Module

The method of the payment is use the credit. Customer will be required to enter his credit card holder's name and the number. *(See Figure 4.6(a.) and Figure 4.6(b.))*

4.2.5 Customer Update Module

This system provides a service for customer to let them feel convenient to change their information. This will be good for the business because the customer information provided is always updated. *(See Figure 4.7)*

4.2.6 Check Order List Module

Customer can only do this module. He can select status of order to view his paid and unpaid order. *(See Figure 4.8)*

4.2.7 Add Product Module

The Management create an e-Product Catalog by adding the information of the products he want to add to the catalog. *(See Figure 4.9)*

4.2.8 Update Product Module

The management department play a very important role to update the products that are lately provided by suppliers. This step is not only to give more choices for customer to purchase products, but also provide the latest information about the products. Therefore, the customer will feel convenient to get more information of the product while doing their issue purchase order. *(See Figure 4.10)*

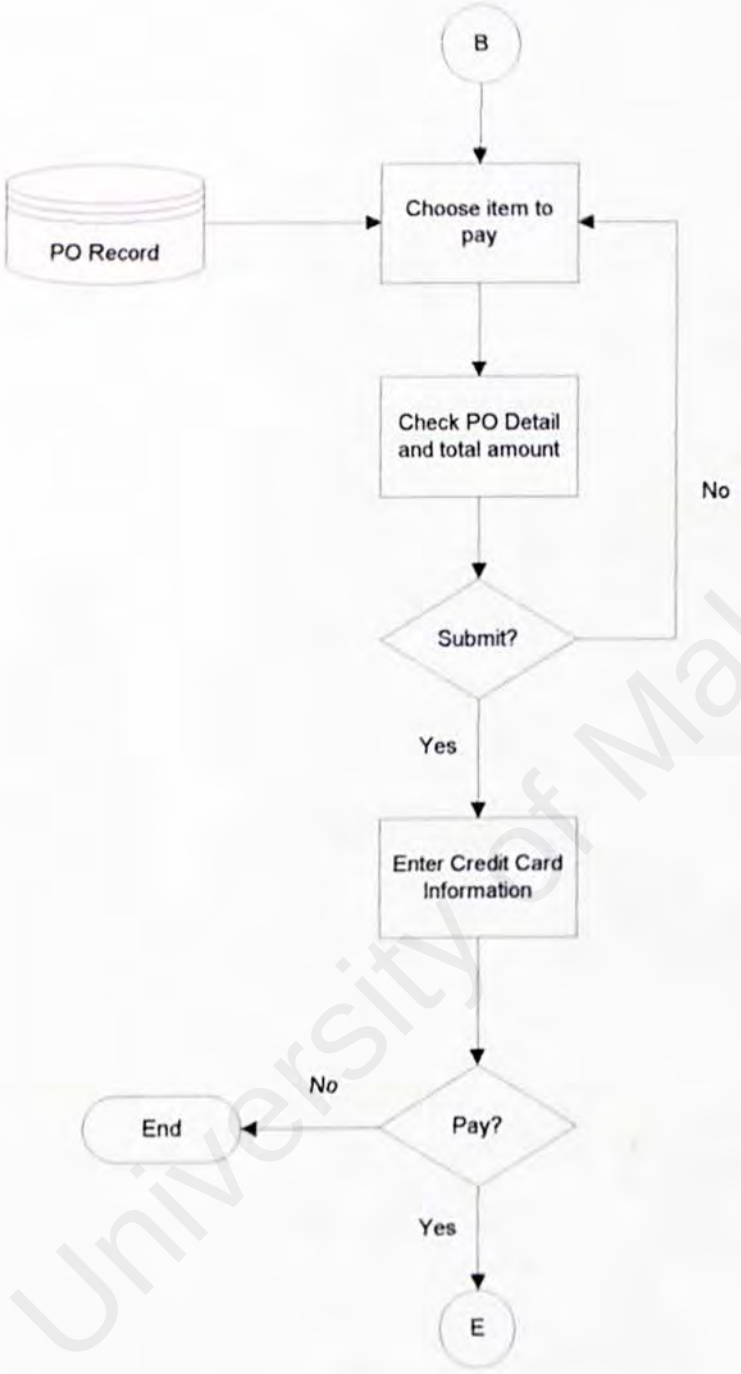


Figure 4.6(a.) Customer Payment Process

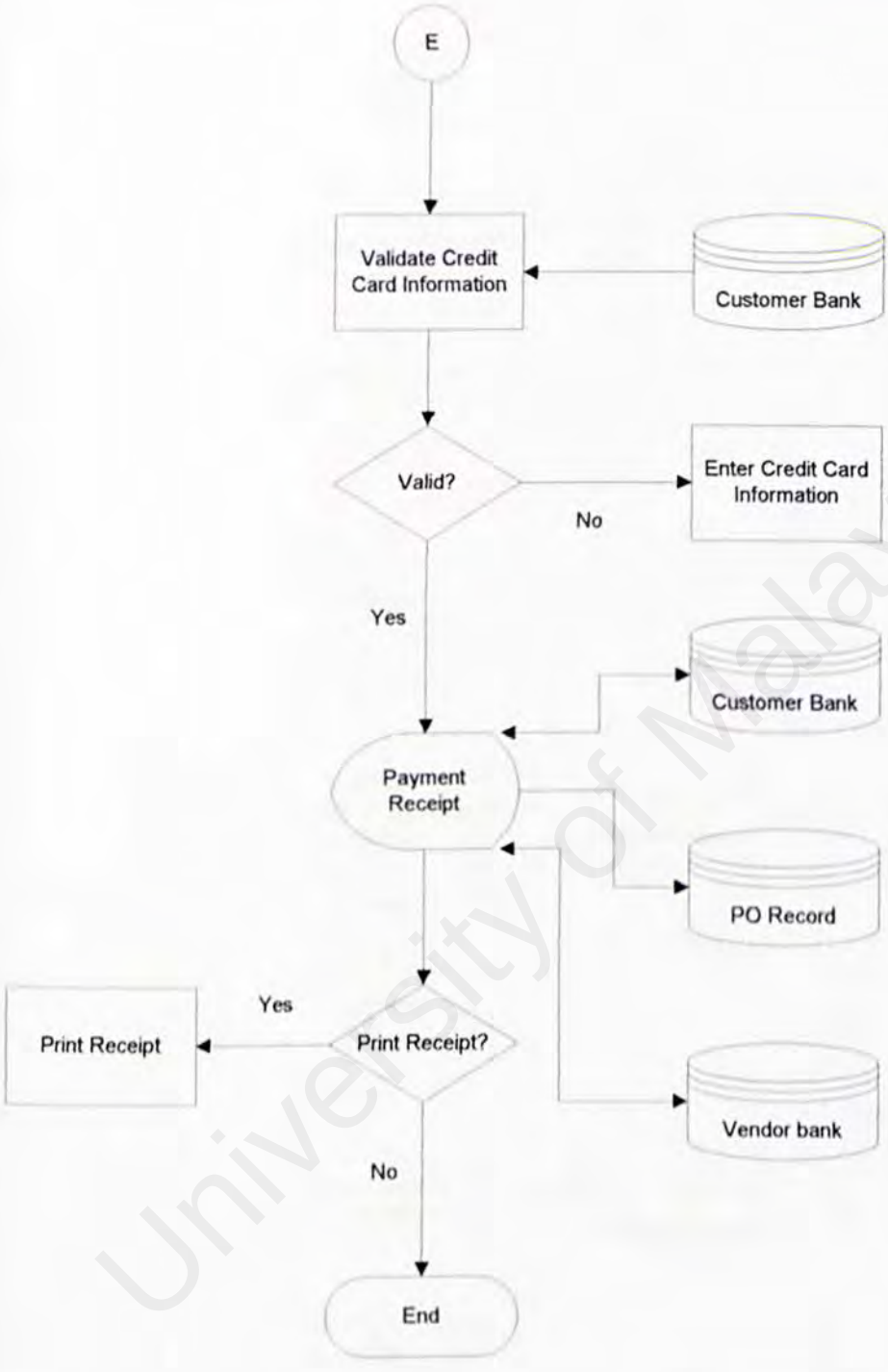


Figure 4.6(b) Customer Payment Process

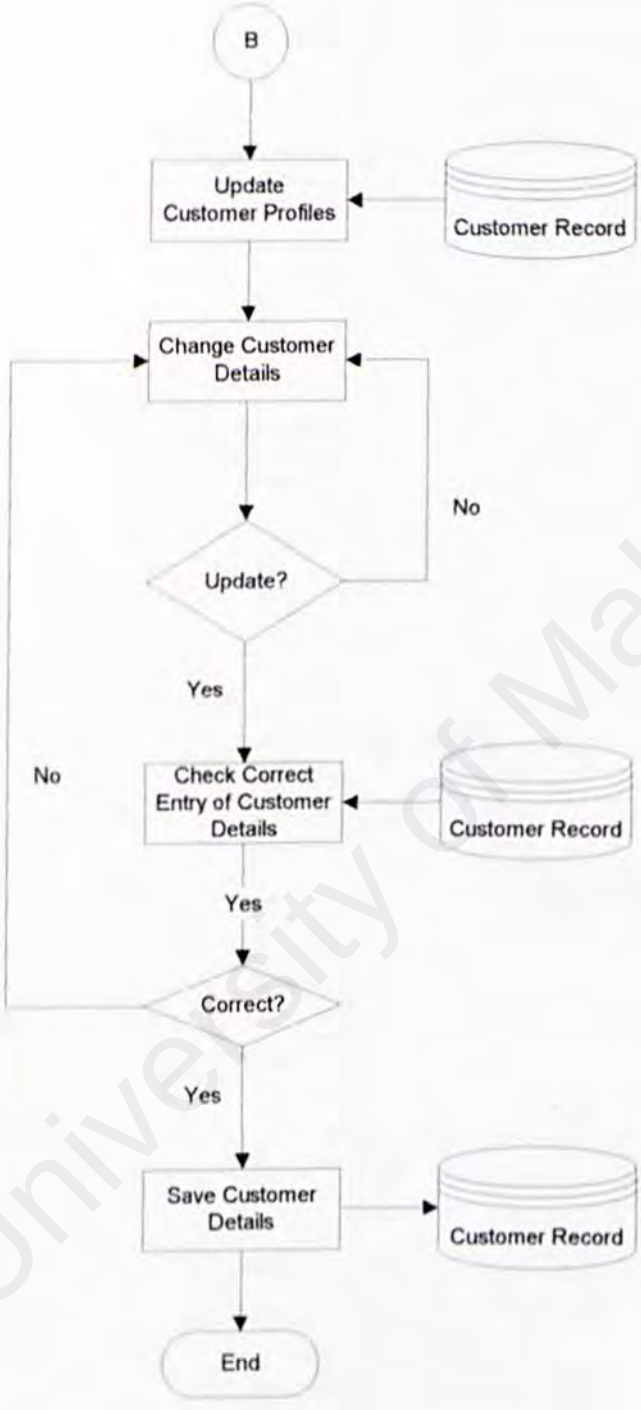


Figure 4.7 Update Customer

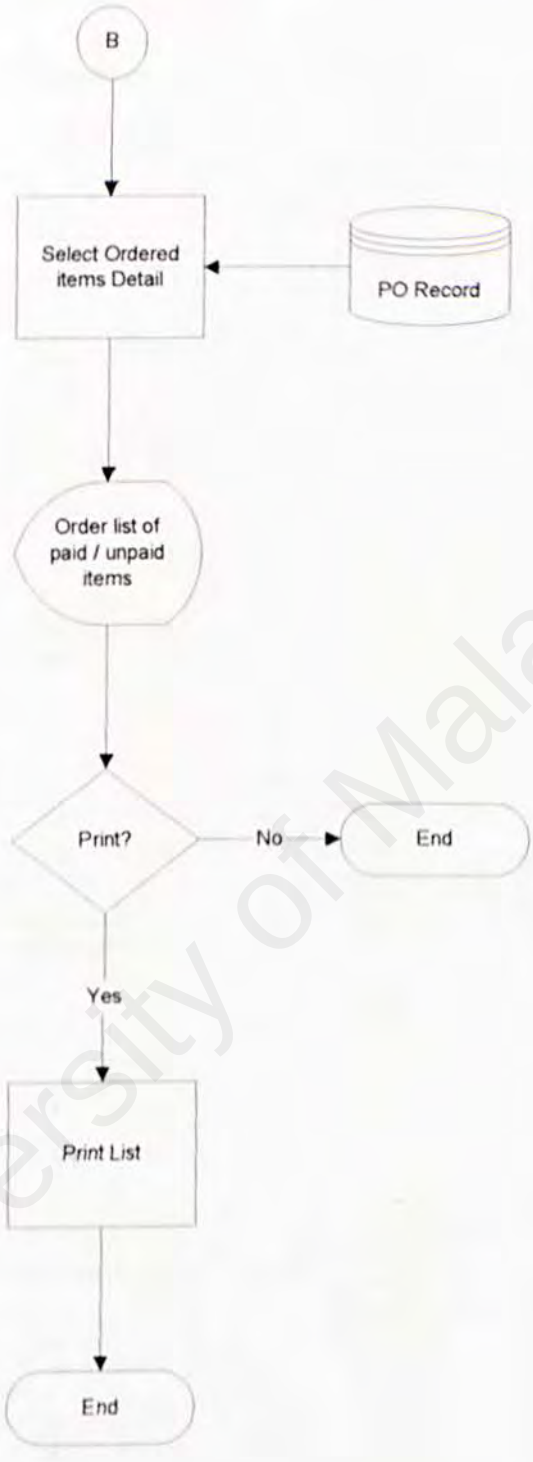


Figure 4.8 Customer Check Order List

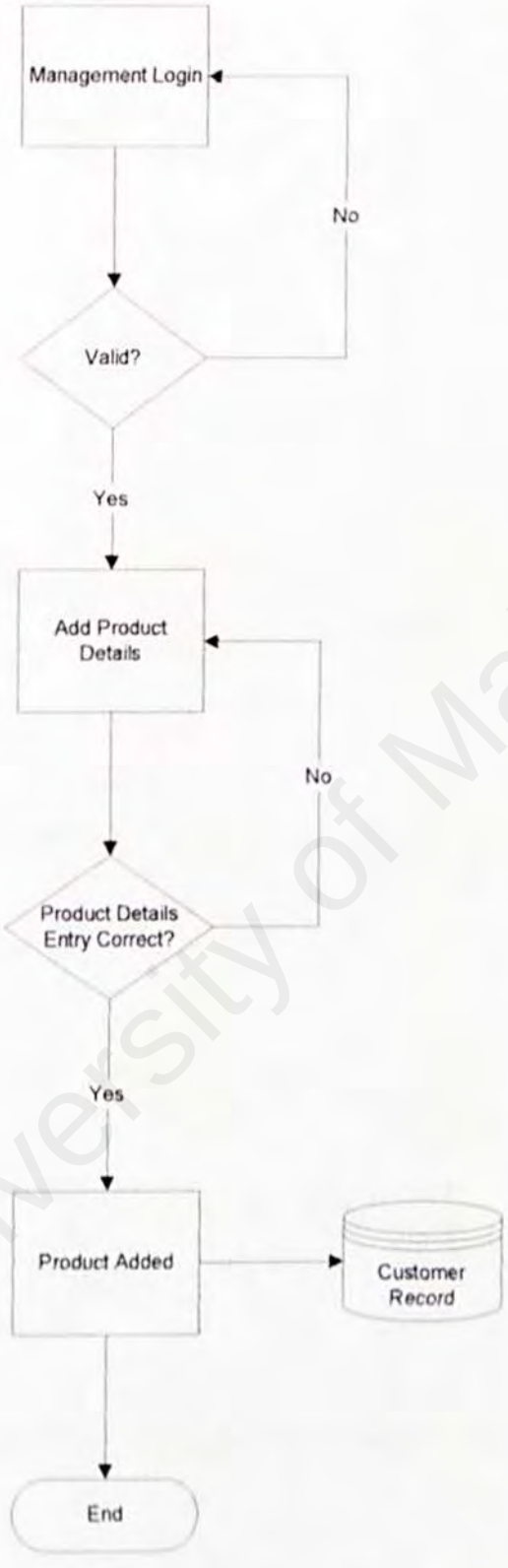


Figure 4.9 Management Add Products

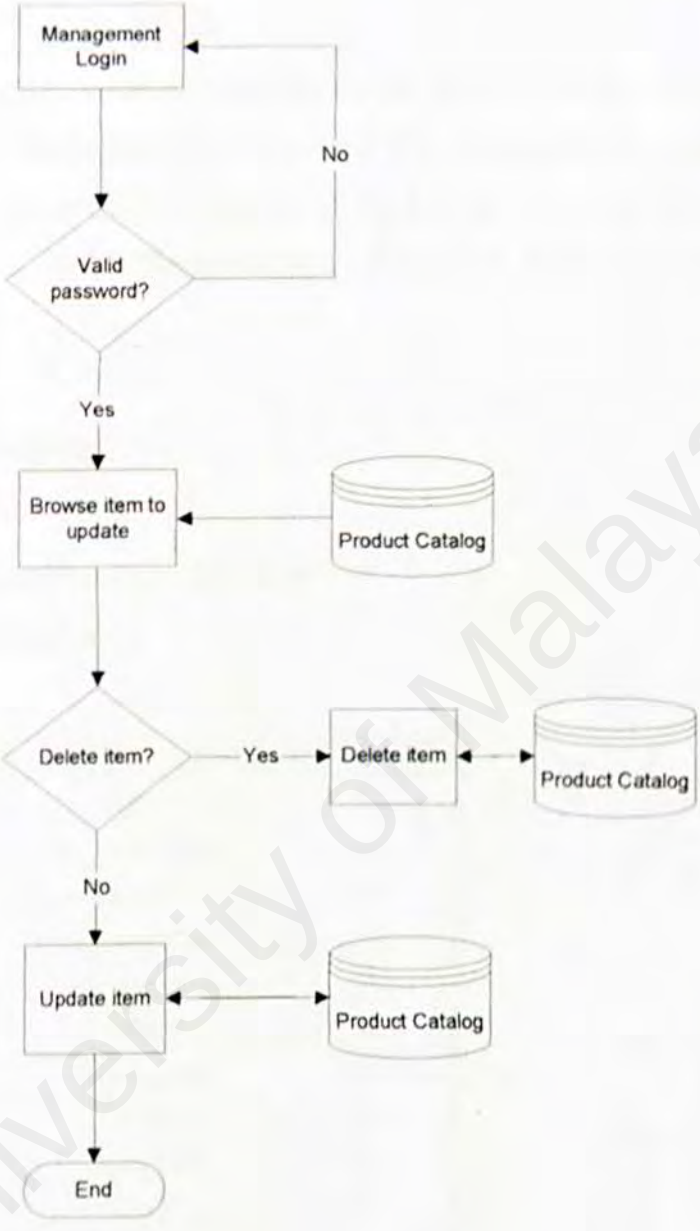


Figure 4.10 Management Update/Delete Products

4.3 Database Design

This system is using Microsoft SQL Server as the database server. It helps maximize availability through online backups, fully integrated log shipping, and enhanced failure clustering. Microsoft SQL Server allows data to be backed up while the database remains online and accessed by users. With differential database backups, it includes the capability to perform differential backups.

4.3.1 Database Tables

The related database tables are shown as figures below:

i) Customers Information

	Column Name	Datatype	Length
🔑	custID	numeric	9
	firstname	nvarchar	50
	lastname	nvarchar	50
	address1	nvarchar	50
	address2	nvarchar	50
	city	nvarchar	50
	state	nvarchar	50
	postcode	nvarchar	50
	phone	nvarchar	50
	icno	nvarchar	50
	emailadd	nvarchar	50
	loginname	nvarchar	50
	password	nvarchar	50

Figure 4.11 Customers Information Table

ii) Virtual Bank (Customer Bank)

	Column Name	Datatype	Length
▶	MemberID	numeric	9
	MemberName	nvarchar	50
	CreditCardNo	char	50
	Address	nvarchar	80
	Telephone	nvarchar	20
	BalAmount	float	8

Figure 4.12 Virtual Bank (Customer Bank) Table

iii) Purchase Order Record

	Column Name	Datatype	Length
	poNum	numeric	9
	custID	numeric	9
	custName	nvarchar	50
	itemID	numeric	9
	itemType	nvarchar	50
	itemName	nvarchar	50
	quantity	char	10
	unitprice	money	8
	totalprice	money	8
	podate	smalldatetime	4
	status	char	10

Figure 4.13 Purchase Order Record Table

iv) Product Details

	Column Name	Datatype	Length
🔑	itemID	numeric	9
	itemType	nvarchar	200
	itemName	nvarchar	200
	itemPath	nvarchar	300
	description	nvarchar	1000
	price	money	8

Figure 4.14 Products Details Table

v.) Vendor Bank Account

	Column Name	Datatype	Length
🔑	CusID	numeric	9
	CreditAmount	float	8
	DebitAmount	float	8

Figure 4.15 Vendor Bank Account Table

4.3.2 Database Relationships Diagram of Tables

The relationships of the relations are defined and a diagram that shows this relationship is in Figure 4.16.

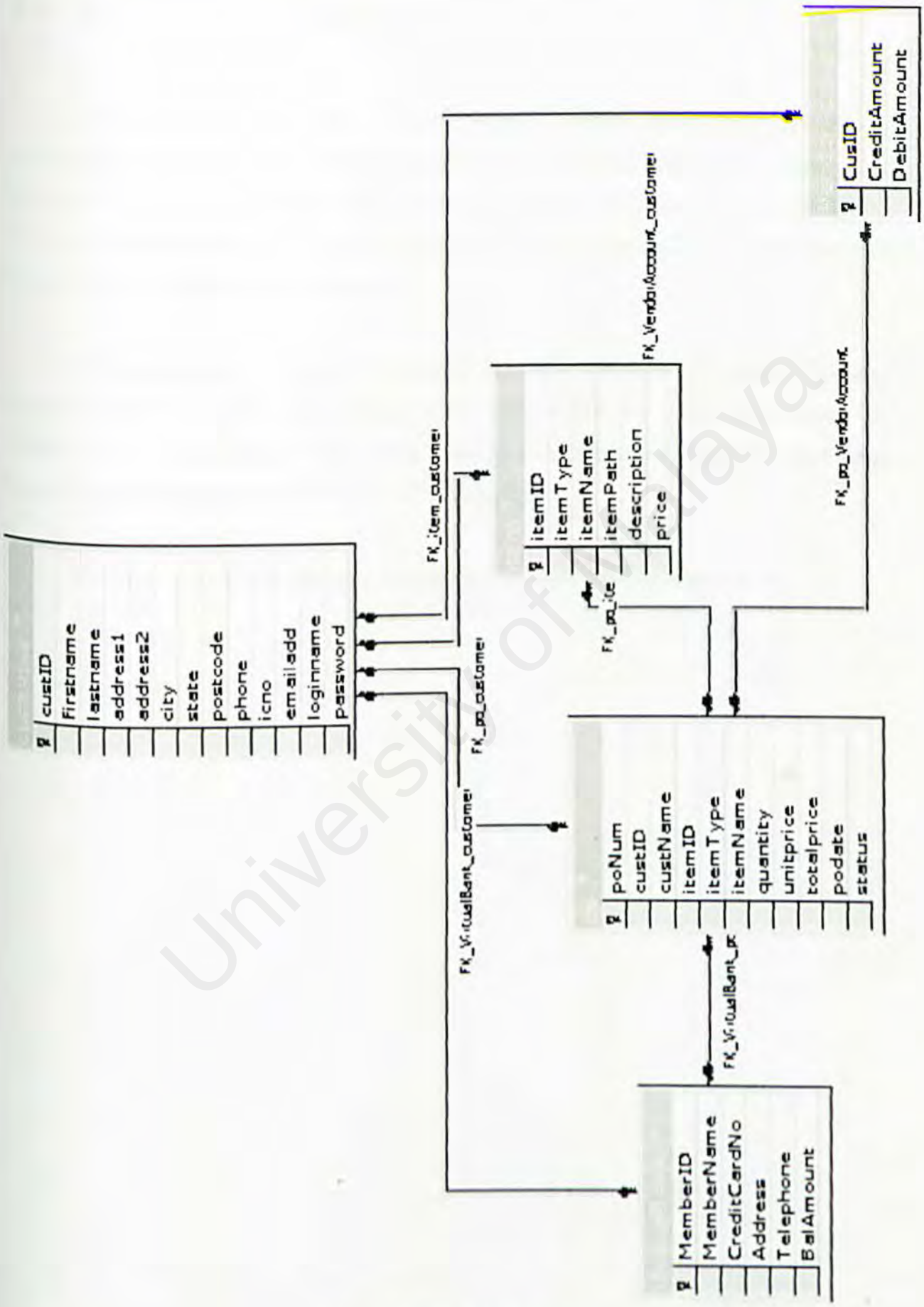


Figure 4.2 DFD of The System

4.4. User Interface Design

User interface designed will base on the Human Computer Interface (HCI) technique that enhance on the efficiency and effectiveness of the interaction between the customer and the system. Many of the forms that are to be created will be designed to the easiness for the users to input data. Built-in or image buttons are used to link and send the forms to the Web server and navigates from a page to another.

The graphics and static content pages are related to the sales and purchase order of products. Normally, either JPEG (which is an acronym for the group that created the software, "Joint Photographic Expert Group") or GIF (which stands for Graphic Interchange Format) is used to enhance the attractive of the web pages.

The figures of the user interface design can viewed in the User Manual.

Chapter 5

System Implementation

5.0 System Implementation

5.1 Introduction

System Implementation is a stage to change the thing from the scratch to the reality. The flowchart design for each module and the file structure design for each table in the database as well as the interface design are move from the design scratch to the real implementation stage by using hardware development requirement and software development tools.

In developing system, the requirements analysis, methodology and system design phases do not have a clear boundary in the software project. Each phase tends to overlap one another. This chapter, system implementation is going to present the process of converting the system requirements that we have stated earlier and designs as we have described into the program codes to develop the system.

5.2 Development Environment

Development environment is very important on the process of developing a good and robust software system. The suitability of the hardware and software chose to develop the system is very important because it will not only help to expedite the system developments but determine the success of the project. The hardware and software tools that had been used to develop the entire system are as stated below:

5.2.1 Hardware Used

The hardware used to develop the system is:

- AMD K6-2 3D Processor
- Memory 320 MB RAM
- 6.4 GB hard disk
- Scanner
- Display Adapter
- Keyboard and Mouse as Input devices

5.2.2 Software and Web Server Used

Software	Purpose	Description
Microsoft Windows 2000 Professional	System requirements	Operating system
Microsoft Internet Information Server 4.0	System requirements	Web server host
Microsoft Visual Interdev 6.0	System development / Interface Design	Development tool for coding
Microsoft Internet Explorer 6.0	System development	Web browser

Microsoft SQL Server 7.0	System development	Database server
Adobe PhotoShop 6.0	Interface design	Image design and creation
Macromedia Flash 5.0	Interface design	Image Animation

Figure 5.1 Software tools used for system

5.3 System Development

System development consists the used of methodology chosen, web pages coding, web-based development tools and database connection. The details are illustrated as below:

5.3.1 Methodology

The development strategy or methodology used in this project is System Development Life Cycle (SDLC) with prototyping as mentioned in Chapter 3. The development of this project will consists of seven stages, which are identifying problems, opportunities and objectives, determination of system requirements, analyzing system needs, designing the recommended system, development and documenting software, testing and maintaining the system and the last one is implementing and evaluating the system. The system is design using logical flow and it allows the estimation of the milestones. Each stage must be completed before proceed to the next stage to ensure that the system is built according to the requirements and specifications.

5.3.2 Web Pages Coding

ASP is actually an extension to your web server that allows server-side scripting and plays a role as scripting environment. The languages used to develop as active server page are HTML together with scripting languages such as VBScript and JavaScript. The challenge of coding in ASP is determining and separating the HTML source code from the scripting counterpart.

5.3.2.1 Server Side Scripting

For server side scripting in this system, forms are created and are to be filled by the client and submitted to the secure Web server. Forms can be submitted using SUBMIT Button:

```
<INPUT Type = "Submit" name = "Submitbtn">
```

The forms use the Submit METHOD as POST. There are POST and GET methods. Instead of using GET for the METHOD attribute of the forms, POST method is used in a form because it buries the information inside the HTTP header, rather than adding it to the URL as a query string.

```
<FORM Name = "frmName" ACTION = "URL" METHOD = "POST">
```

Data stored in Request object collections originates from the client, and is passed to the server as part of the HTTP document request. The information from the FORM is posted to the Request collections. The Request object, Response object, Server object, application object and Session object are used in this project. For example, the Client Information Form contains the inputs that had been entered by the client and is posted to submitted page together with a query string. To retrieve the information in the form, we use Request.Form collection.

Session is used to provide support for applications across the web, Active Server Pages also supports sessions within an application. ASP allows us to track a user from page to page in an application through the use of a session. Session variables are stored in Session object. The initial events that occur every time the client visits the Web page will need to be initialized in the Global.asa file. A Global.asa file stores the information of the initial events occurs when client visits the Web page. To create a Session-wide instance of

the connection, we need to code the Session – onStart() and Session_onEnd() functions in Global.asa.

5.3.2.2 Client Side Scripting

JavaScript is used as the client side scripting language as we have discovered that the VB Script is not functioning properly in Netscape Navigator browser if it is used as the client side scripting language. The client side scripting is used to validate that proper input is entered from client and used to make the Web site more interesting.

5.3.3 Web-based Development Tools

Microsoft Visual Interdev 6.0 is used as the main development tool for this project. This tool enables easy performance of the many complex programming and database tasks required in the creation of a Web site, as well as the incorporation of HTML formatting and layouts, graphics and other multimedia components.

Microsoft Visual Interdev 6.0 will creates a second copy of the files on the local computer while performing tasks like adding files to the Website or editing any of the existing files. This is called the working copy and whenever these working copies are saved, Visual Interdev 6.0 will updates the file on the Web server as well. All the graphics and animations in this project are created using Microsoft Visual Interdev 6.0, Adobe PhotoShop 6.0 and Macromedia Flash 5.0.

5.3.4 Database Connection

The database for this project is created using Microsoft SQL Server 7.0. By using the SQL Server, the database can be accessed through virtually any kind of network connection and enable great amount of users accessed the system at the same time.

ActiveX Data Object (ADO) is used to store and retrieve data from the database. This project uses the (Data Source Name) DSN-less connection strings to connect to Microsoft SQL Server. The connection string is written as:

Driver = {SQL Server}; Server = ServerName; Database = dbName; ID = ; PWD = ;

All communication with a database takes place through an open connection. Before any information can be inserted into or retrieved from the database, a connection with the database must be established. The ADO connection object serves the purpose. For example:

```
Set objConn = server CreateObject ("ADODB Connection")
ObjConn.Open strConnect
```

Therefore, by using the connection, all the tables, as shown in chapter 4 can be connected between the database and the user by using the web scripting.

Chapter 6

System Testing

6.0 System Testing

6.1 Introduction

System testing is a process of executing a program with the intention of finding bugs, errors or defects that present in the system. System testing also can be defined as the process of analyzing a software item to detect the difference between existing and required conditions and to evaluate the features of the software items.

There are several objectives of system testing as stated as below:

- To demonstrate that behavioral and performance appear to have been met
- To demonstrate that software functions appear to be working according to the specification and user requirement.
- To reveal different classes of errors with a minimum amount of time and effort

Data collected as testing is conducted provide a good indication of software reliability and some indication of software quality as a whole. However, testing cannot show the absence of errors and defects, it can show only that software errors and defects are present. This project was tested with the following generic characteristic:

- Testing begins at the module level and works "outward" toward the integration of the entire system.
- Different testing techniques are appropriate at different points in time.
- Testing and debugging are different activities, but debugging must be accommodated in any testing strategy.

6.2 Testing Principles

Several testing principles suggested by Davis (1995) have been followed in testing the system [15]:

- All tests should be traceable to customer requirements.
- Test should be planned long before testing began. Testing planning can begin as soon as the requirement model is complete.
- Testing should begin "in the small" and progress toward testing " in the large". The first test planned and executed generally focus on individual components. As testing progress, focus shifts in an attempt to find errors in integrated clusters of components and ultimately in the entire system.

6.3 Unit Testing

This testing focuses verification effort on the smallest unit of software design, which is the software component or module. All the important control paths in this project are tested to uncover errors within the boundary of the module. The relative complexity of tests and uncovered errors is limited by the constrained scope established for unit testing. The unit test usually white-box oriented and the step can be conducted in parallel for multiple components.

The tests that occur as part of unit tests are illustrated schematically in Figure 6.1 below [16]. The module interface is tested to ensure that information properly flows into and out of the program unit under test. The local data structure is examined to ensure that data stored temporarily maintains its integrity during all steps in as algorithm's execution. Boundary conditions are tested to ensure that the module operates properly at boundaries established to limit or restrict processing. All independent paths (basis path) through the control structure are exercised to ensure that all statements in a module have been executed at least once. Finally, all error-handling paths are tested.

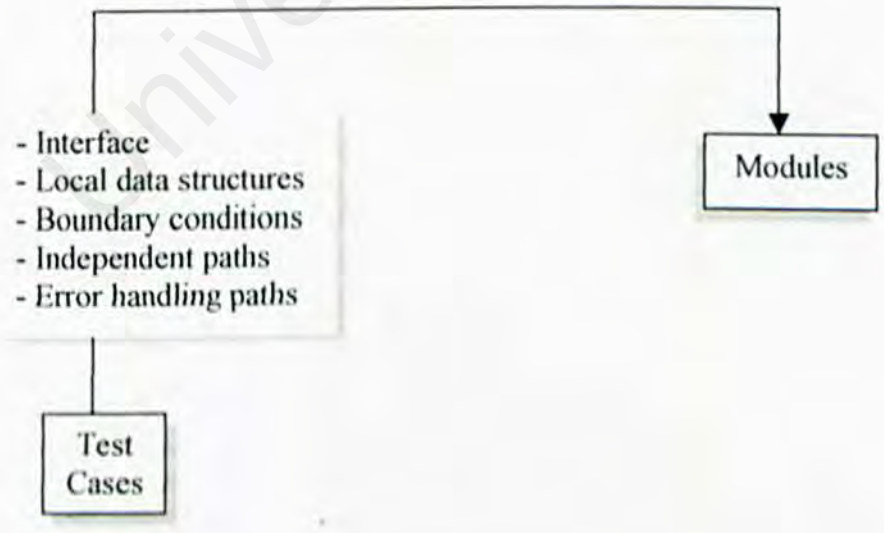


Figure 6.1 Unit Testing

The following areas were tested during unit testing for this project:

- Boundary value analysis

  Ensure that the module operates properly at boundaries established to limited or restrict processing.

- Error handling paths

  Ensure that the specific module executes the recovering process should an error occurs. For example, the updating process should be able to continue to function again after encountering duplicate record in the database.

- All possible independent program paths are executed ensure that the control structures are implemented correctly.

6.4 Integration Testing

This kind of testing [15] is a systematic technique for constructing the program structure while at the same time conducting tests to uncover errors associated with the interfacing. The objective is to take unit tested components and build a program structure that has been dictated by design. This testing will ensure that the interfaces such as module calling in this project are arranged correctly.

The approach used in this phase is an incremental integration strategy, the bottom-up integration and regression testing. The incremental integration is the antithesis of the high bang approach. E-Commerce Web page program is constructed and tested in small increments where errors are easier to isolate and correct. All the interfaces are tested completely and a systematic test approach is applied.

For this project, a bottom-up approach has been used. Bottom-up integration testing begins construction and testing with modules at the lowest levels of the system and then moving upward to the modules at the higher levels of the system. Regression testing is the re-execution of some subset of tests that already been conducted to ensure that changes have not propagated unintended side effects. It is the activity that helps to ensure that changes (due to testing or for other reasons) do not introduce unintended behavior or additional errors.

6.5 Validation Testing

A final series of software tests that is the validation testing are carried out during this phase. Software validation is achieved through a series of black box tests that demonstrate conformity with requirements. For this project, a test plan outlines the classes of tests to be conducted and a test procedure defines specific test cases that will be used to in an attempt to uncover errors in conformity with requirements. Both the plan and procedure are designed to ensure that [18]:

- All functional requirements are satisfied
- All behavior characteristic are achieved
- All performance requirements are attained
- Documentation is correct
- Other requirements are met (e.g. error recovery, maintainability, compatibility)

Alpha test and beta test are also being carried out to uncovers errors that only the end-user seems able to find. Alpha test is conducted at the developer's site by an end-user in a controlled environment. Beta test is conducted at one or more customer sites by the end-user of the software and it is a "live" application of the software.

6.6 System Testing

System testing is a series of different tests designed to fully exercise the software system to uncover its limitations and measure its capabilities. The objective is to test an integrated system and verify that it meets specified requirements. Although each test in this project has a different purpose, all work to verify that system elements have been properly integrated and perform allocated functions.

There are several types of system testing that are worthwhile for a software system. For this project, three types of system testing are used [14]:

- Recovery Testing

  It is a system test that forces the system to fail in a variety of ways and verifies that recovery is properly performed. If recovery is automatic (performed by the system itself), then reinitialization, checkpointing mechanisms, data recovery and restart are evaluated for correctness. If recovery requires human intervention, the mean-time-to-repair (MTTR) is evaluated to determine whether it is within acceptable limits.
- Security Testing

  These system tests will attempts to verify that protection mechanism built into the system will protect it from improper penetration.
- Performance Testing

  The purpose of this testing is to test the run-time performance of software within the context of an integrated system. It requires both hardware and software instrumentation. Resource utilization is measured in an exacting fashion.

6.7 Error Handling and Debugging

An error handling enables the development of clearer, more robust and more fault-tolerant programs. Error handling provides the ability to attempt to recover from infrequent fatal errors rather than letting them occur and suffering the consequences (Deitel, 1999).

Debugging is the process of finding and correcting errors or bugs in the source code of computer program. There are number of debugging tools being used in performing the system debugging, including Toggles Breakpoint, Step Into, Add Watch and so on. When debugging the system, the Locals windows and immediate window are used to check the value of variables.

Chapter 7

System Evaluation

7.0 System Evaluation

There are various problems were encountered. These entire problems were solved through research and studies. Every system also has it own strengths, limitations and future enhancements where can be identified.

7.1 Problems Encountered and Solutions

There are some problems encountered throughout the development of this system as mentioned below:

7.1.1 Difficulty in Choosing a Suitable Development Technology, Programming Language and Tools

Many software tools available to develop a website as stated in the earlier stages such as Microsoft products, Java and so on. In order to choose a suitable technology and tools to develop the system was a critical process as all the tools possesses their own strengths and weakness. In addition, the availability of the required tools for development was also a major consideration.

Research and evaluation had been carried out before the decision was made. Furthermore, seeking advice from supervisor and referred to the similar project had helped in choosing the most suitable tools for this project.

7.1.2 Lack of Knowledge in ASP and VBScript

The scripts programming languages and concepts were never been taught before in the faculty and to implement such an application requires a fair grasp of the languages. These programming approaches seem to be totally different from the traditional programming languages. Besides, since there was no enough prior knowledge of programming in ASP and VBScript, there was an uncertainty on how to organize the cods in the web pages.

Although it really cause a lot of time to learn the new technology, but choosing to program in ASP and VBScript proved to be a wise move. Most of the problems faced were manageable through browsing the Internet for related materials and referring to the reference books available in the market. Discussion with friends using the same software was a great help. However, the most efficient method of learning is by trial and error method during the coding phase.

7.1.3 Readability Problem in ASP

Many web-based programming languages do not support for variety types of variable. It increases the write ability for programmer but at the same time decrease the readability for the programmer. Problems become more tedious when there are bugs detected in the program. Since the readability of the program is decreased, then the code maintainability also decreased. It is very difficult to debug the errors especially semantics errors that are unable to be detected by the debugger engine.

In order to minimize the problem in this area, a series of testing must be taken if the components are to be used in implementation of this project. Minimization in using the component is need for a stable system.

7.2 The Strengths of The System

During the development of this project, several system strengths had been identified as below:

7.2.1 Attractive and Simple Graphic User Interface

The NH Group Website has an attractive user interface and made users feel comfortable in browsing the website to get the information they want or the features that will add value to them. The commands and the layout of this system are simple and well organized, therefore it is easy to use, simple to learn and understandable. Normal users with some computer knowledge will find the system easy to handle.

7.2.2 User Friendliness and Easy to Use Interface

Some useful Graphical User Interface (GUI) such as command buttons, check boxes and drop-down list boxes are provided in the entire system, which attract the users to navigate through the system and give faster access. This user-friendly interface can shorten the learning curve and reduce training costs, which include money and time. The menu-driven and pop-up windows or pull-down menus are built to facilitate the individual needs of the users.

7.2.3 Different User Privileges

Except for the customers and administrator need to login before the can perform their task and view the important information. The access right of each user is clearly differentiated and they are using the same interface to improve the system reusability.

7.2.4 High Response Time for Data Retrieval

This system is designed in such a manner that they are loaded in a reasonable amount of time to ensure users need not wait for a long time to view the pages. Heavy graphics are avoided and ActiveX controls are kept to the minimum wherever possible.

7.2.5 Provide Database Access

All the data are organized and stored in the form of database using Microsoft SQL Server. It is real-time database information and any changes made to the records can be updated instantly to the time city database.

7.2.6 System Security

User name and password are required to access the certain modules of the system and only the authorized user is allowed to view the important information and features. For example, only the authorized administrator can access to the system to do some administration tasks.

7.3 System Limitations

As in other systems, there are also several setbacks and limitations in NH Group Website. These limitations can be addressed in future development and system enhancements.

7.3.1 Payment Transaction Method – Credit Card

This entire system is using only one method of payment to let customer to make their payment transaction that is credit card. The customer is also unable to apply a new credit card by using this system. The customer can only apply credit card with any one of the credit card company before doing their payment transaction.

7.3.2 Lack of Expected Firewall

Firewall normally is used to create security checkpoints at the boundaries of a private network. By providing the routing function between the private network and the Internet, firewall inspect all communications passing between the two networks and either pass or drop the communications depending on how they match the programmed policy rules.

7.4 Future Enhancement

Further development and many new ideas have come about while the system being implemented. Owing to time constraint and other factors, not all of the ideas could be incorporated into the system. It is hoped that the following aspects could be considered in future:

7.4.1 Provide More Methods of Payment Transaction Method

This system is proposed to have more that one method of payment transaction not only use a credit card. A customer also can have the alternates to pay by other methods such as money order or online saving account transaction. This online saving account transaction can be used when a customer get a password from the system and he can pay by just entering his password and bank saving account number.

7.4.2 Develop a Credit Card Application Through the System

The entire system can be linked with the bank to let the customer apply their new credit card to make their payment transaction. This might give the very convenient way for the customer to apply card and pay on the spot. It also can attract as many as customer to use the system to shop with the company.

7.4.3 Error Detection Features

This system actually needs a more comprehensive error detection feature to ensure that only valid input is being passed to the server and it is done through client-side scripting. This is important in ensuring that the system is robust and easy to maintain the reliability of the system.

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